FIREMAN'S GUIDE

FIRE HANDBOOK

CALIFORNIA REGION

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CALIFORNIA REGION

BY

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This Chapter Guide is provided to assist you in quickly locating the Chapters in the Fireman's Guide.

The page at the beginning of each Chapter has a black square in the position corresponding to the position of the square on the Chapter Guide.

By flipping through the pages in the book you can easily locate the square at the beginning of the Chapter you want to find.

CHAPTER GUIDE

FIRE PREVENTION AND LAW ENFORCEMENT

PREPAREDNESS

LOOKOUT DUTIES

FIRE BEHAVIOR AND FIRE DANGER RATING

STANDARDS OF LINE CONSTRUCTION

FIRE SUPPRESSION

ORGANIZING FOR FIRE SUPPRESSION

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Good radio use practices

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INTRODUCTION

FOREWORD

This section of the California Region's Fire Handbook contains techniques, practices, instructions, and standards for the Forest Fireman. It is designed and written for the man on the job in the California Region. For this reason the authors have called it the "Fireman's Guide".

ACKNOWLEDGMENT

In order for the authors to properly acknowledge all of the assistance they received in the preparation of the Fireman's Guide, they feel that a brief historical account of the preparation is necessary. Fire Control people in the Region have always recognized the lasting value of the material contained in the 1937 Fire Control Handbook for Forest Guards. There was a feeling, however, that a real need existed to revitalize and modernize this useful fire control tool. The years of use had indicated where improvements could be made. In 1952 the decision was made to undertake a rewrite of the handbook.

Since the objective was to obtain a product of real value to field men, the job was given to field men to accomplish. A call was made on the talent and experience of many men in the Region. Fire Control Officers, Rangers, Dispatcher, Fire Control Assistants -- men from almost every type of job were assigned to task forces to write or review material for the book. The authors sincerely appreciate the help of all these men.

Much of the material in the 1937 Fire Control Handbook of R-5 was used. Material from the handbooks and guides of other Regions, Experiment Stations and other Agencies was also included. Had this material not been available the task of the authors would have been more difficult.

In addition the authors wish to express their particular appreciation to William Deemer of the Arcadia Equipment Development Center and to Lee Hollenbeck of the Plumas National Forest, and to Clyde Walker of the California Forest and Range Experiment Station for editorial assistance.

PURPOSE OF THIS HANDBOOK

1. To describe approved practices that will aid the fireman in his work.

2. To establish standards of performance for the man on the job, and those who supervise his work.

3. To give brief instruction on the practices, tactics, and techniques that have been proven on many fires.

HOW TO USE THIS HANDBOOK

1. Every fireman is provided with a copy. Its makeup is is intended to provide a ready reference for field use. Keep it with you.

2. Briefly thumb through its pages. This will give you an idea of the contents.

3. Then read and study each chapter. Answer the review questions. If you do not know the correct answer, look through the material until the solution is found.

4. Apply the problems to areas in your country. Visualize the situations on the fires you have fought. Think of the handbook in terms of the country you are familiar with.

5. Check the table of contents and the index and learn how to use them for ready reference.

6. Study the glossary and learn the meaning of all unfamiliar terms.

7. Refer to the appendix for the items which concern your job.

8. Every two or three weeks briefly review the questions at the end of each chapter. If you have forgotten the answer, study the material again until you know the solution. Your Ranger or F. C. A. will ask these questions frequently on inspections to determine if you have a good knowledge of the job.

LOCAL INSTRUCTIONS

You will be furnished a Letter of Instructions by your District Ranger or his Assistant. These instructions should be placed inside the front cover of this book. The instructions will apply specifically to your particular job. They should include:

1. A list of items in this book which you should study. They pertain to your job and your territory or area of responsibility.

2. Safety instructions which emphasize special hazards of your job.

3. A schedule of work to be done. (Job list)

4. Schedule for daily radio or telephone check calls.

5. What to do if your means of communications fail.

6. The hours you work each day and your off-duty days.

7. A list of publications you should study for more detailed coverage of specialized firefighting instructions. For example: "Water vs Fire" to cover the use of water in fighting fires.

8. Your authority to enforce laws.

9. Other items as they pertain to your job.

CONDITIONS OF HIRE FOR FIREMEN

MEDICAL EXAMINATION

All fire-going members of the fire control organization are required to take a physical examination at their own expense. Forms for these examinations are provided by the Forest Service, covering the requirements of the particular position. Lookouts, and others working in isolated locations and at upper elevations, will also need to pass medical examinations each year. Eye tests for Lookouts are given by the District Ranger or Fire Control Assistant.

SUBSISTENCE

Most firemen supply their own food using government mess gear and cooking facilities. If you are subsisting yourself in an isolated location, you are required to keep at least a 2 weeks' supply of food on hand. If you live in a government-subsistee camp, a payroll deduction is made for all meals. You will be informed of the standard cost per meal. You will not be charged for meals eaten at fire camps (camps maintained at scene of fire) nor for emergency rations eaten at fires.

QUARTERS DEDUCTION

Most firemen live in government-owned quarters. If you reside in a tent or lookout tower observatory, you are not required to pay for quarters. If you live in a barracks, a dwelling, or personal quarters separate from the lookout observatory, you are charged for quarters. Charges vary with location and type of dwelling and will be deducted from your pay check each payroll period.

TRAVEL EXPENSES

At times you will be assigned a job which requires you to be away from your station overnight or longer and involves expenses for lodging and subsistence. For example: You may be sent a long distance to a fire on another forest. En-route to or from the fire it may be necessary to buy a few meals or, rarely, hotel accommodations. If possible, you should have some cash on hand for these trips. You will be reimbursed at a set rate for your expenses. This is called "per diem".

You will be issued a Travel Authorization stating your per diem rates. One-fifth of your per diem rate will be deducted for each meal or night's lodging furnished by the government without cost to you. While you are traveling it will be necessary for you to keep a record of the beginning and ending time of such travel, the days you spend in a government camp, and the meals and lodgings furnished by the government.

If you are required to furnish a car for your official travel, you will be paid at the mileage rate shown in your Travel Authorization. It will be necessary to keep a record of such official travel, showing the time and speedometer reading at the beginning and ending of each trip. When you are required to use your pack or saddle stock on the job; forage will be furnished by the government. This feed is furnished only for the period that you are required to have the stock on the job.

LEAVE

Annual Leave

If you are a new employee or are being reemployed after a break in service, you are entitled to earn annual leave after being employed for a continuous period of 90 days. Such a continuous period will be broken by any actual separation from service for one or more working days. Non-pay or non-work status does not constitute a separation from service. If you have actually been separated from service (terminated) you must serve another 90-day qualifying period before you can be credited with leave on your current appointment. When your 90-day employment period is completed, you will be credited with the annual leave you earned during the period. (Annual leave earnings are based upon the amount of your previous Government Service -- Civil and Military.)

Annual leave is earned according to the following rules:

1. 1/2 day for each full bi-weekly pay period in the case of employees with less than 3 years of service.

2. 3/4 day for each full bi-weekly pay period in cases of 3 but less than 15 years of service, and

3. One day for each bi-weekly pay period in cases of fifteen or more years of service.

Sick Leave

You earn sick leave at the rate of four hours for each full pay period, but receive no credit for fractional parts of pay periods worked. For example, if your employment starts within a pay period rather than on the first day of the bi-weekly pay period, you earn no sick leave for that pay period. But you will earn four hours for each full pay period worked after that. No prior service or waiting period is required.

CHAPTER I

FIRE PREVENTION
AND
LAW ENFORCEMENT

FIRE PREVENTION

GENERAL PRINCIPLES

There is no honor attached to the detection and suppression of a fire, if you could have prevented it. A fire prevented is a fire that does not have to be put out.

Nine out of ten forest fires in California start from human carelessness. The tenth fire is caused by lightning. All fires which are caused by human carelessness are termed "man-caused fires".

To do a good job of fire prevention you must know something about how fires start and who starts them.

RISKS AND HAZARDS

Man-caused fires are the result of a combination of "hazards" and "risks".

A "hazard" is any burnable material. Some are man-made such as trash, rags, paints, or slash. Others are the result of nature, such as dry grass, pine needles, and dead and fallen trees. Some hazards are more dangerous than others. For example, dry leaves burn more readily than green leaves. If there is a great deal of dry fuel in one place, the hazard is referred to as being "high".

"Risks" are those things which cause fires to start. Examples of risks are matches in the hands of children, hot ashes, sparks from chimney flues, a man smoking, logging crews, hikers, and hunters.

Records show that about 60 percent of all man-caused fires in California forests are caused by forest residents (risks), and local people who work in the forest (risks). The remaining 40 percent are caused by visitors (risks) from more distant places.

RISK PLUS HAZARD = POSSIBLE FIRE

When risks and hazards are combined, the result is sometimes a fire. Your job is to prevent fires by:

1. Removing the hazards, or
2. Controlling the risk.

WORKING WITH HAZARDS AND RISKS TO PREVENT FIRES

The following illustrations will help you to recognize some of the dangerous combinations of hazards and risks which may cause a fire. They also show how these same hazards and risks can be treated to prevent a fire.

HOW TO PREVENT FIRES

POSSIBLE FIRE

Fig. 1
SMOKING WHILE TRAVELING
Glowing tip knocked off cigar into flashy fuels.

FIRE PREVENTED

Fig. 2
STOPPING TO SMOKE IN SAFE AREA
All hot material falls onto bare ground in cleared area.

POSSIBLE FIRE

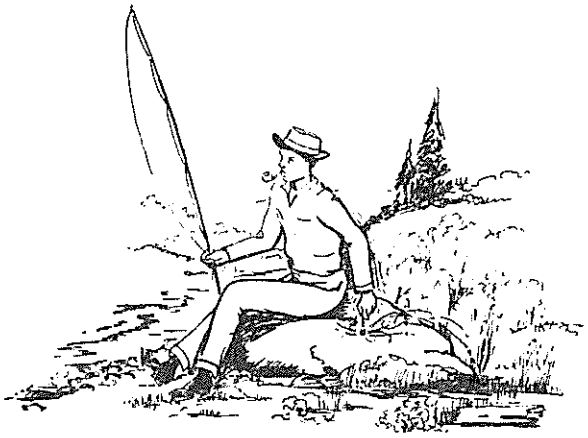


Fig. 3
SMOKING IN UNSAFE AREA
Head flies off match into dry grass.

FIRE PREVENTED

Fig. 4
SMOKING IN SAFE AREA
Hot material would fall on barren gravel bar.

POSSIBLE FIRE

Fig. 5.
GRINDING OUT CIGARETTE BUTT IN PUNKY LOG
Sparks can start fire easily in rotten wood.

FIRE PREVENTED

Fig. 6
GRINDING OUT CIGARETTE BUTT ON FLAT ROCK IN CLEARED AREA

POSSIBLE FIRE

Fig. 7
DANGEROUS CAMPFIRE

Fire can escape:

1. In any direction by creeping through duff which is not cleared.
2. Into the woodpile and up the slope.
3. By spreading to branch too close to fire.
4. By spark igniting old punky log.

FIRE PREVENTED

Fig. 8
SAFE CAMPFIRE

1. Inflammable ground cover cleared to mineral soil 5 feet in all directions from fire.
2. Woodpile away from fire on windward side.
3. Fire kept small as possible.
4. Fire built away from dangers such as steep slopes, rotten logs, trees and overhanging branches.

POSSIBLE FIRE

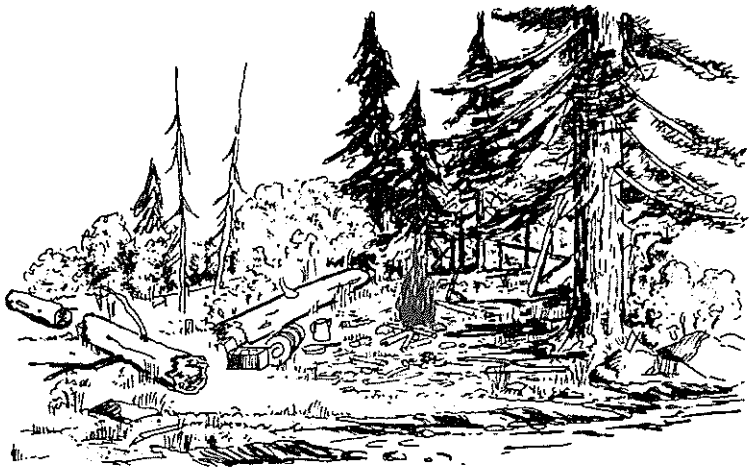


Fig. 9

UNSAFE AREA, BUT ATTRACTIVE TO FISHERMEN

Dead trees, accumulated leaves and twigs, make this area unsafe for campfires. However, it is a level, shady area beside a mountain stream - fishermen like this kind of place to camp.

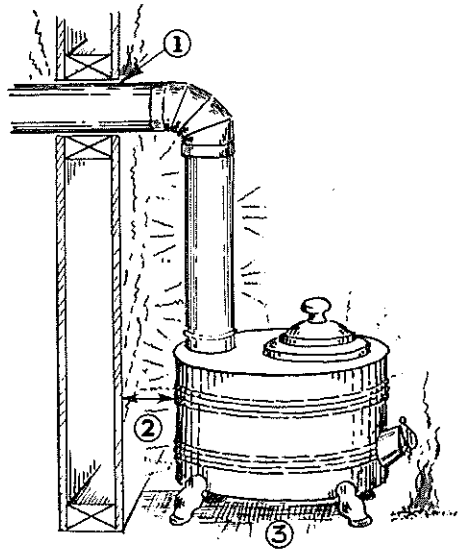
FIRE PREVENTED

Fig. 10

SAME AREA - FIREPROOFED

Dead saplings, leaves, and twigs carried away or piled and burned in safe place. Brush and green saplings thinned out. Larger trees left for shade. Overhanging branches pruned.

POSSIBLE FIRE

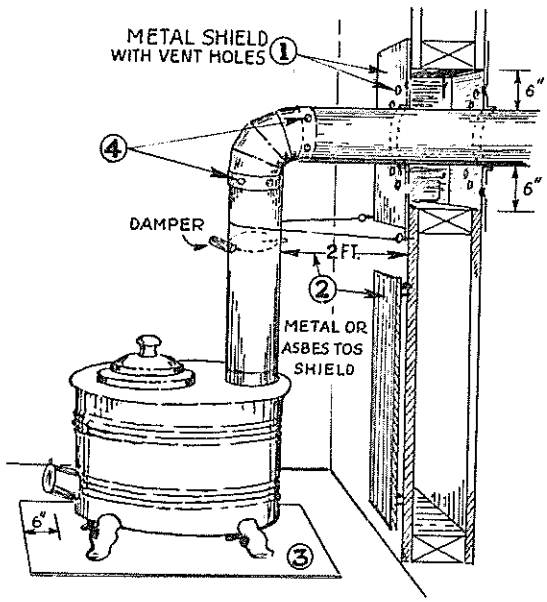


IMPROPER STOVE INSTALLATION

1. Stovepipe through wall (or ceiling) without adequate clearance and insulation.
2. Stove placed too close to wall without shield.
3. Stove too close to wooden floor without shield.

Fig. 11

FIRE PREVENTED



PROPER STOVE INSTALLATION

1. Stovepipe out from wall and insulated where it goes through wall (or ceiling).
2. Stove out from wall. Wall shielded with metal or asbestos.
3. Piece of metal or asbestos on floor underneath stove.
4. Stovepipe held together with metal screws.

Fig. 12

POSSIBLE FIRE

Fig. 13

IMPROPER STORAGE OF PAINT, OILY RAGS, AND OTHER INFLAMMABLE MATERIALS

Old rags, newspapers, and paint left around indiscriminately - gasoline can tipped over, spilling gas. Sun shining through bottle onto inflammable materials.

FIRE PREVENTED

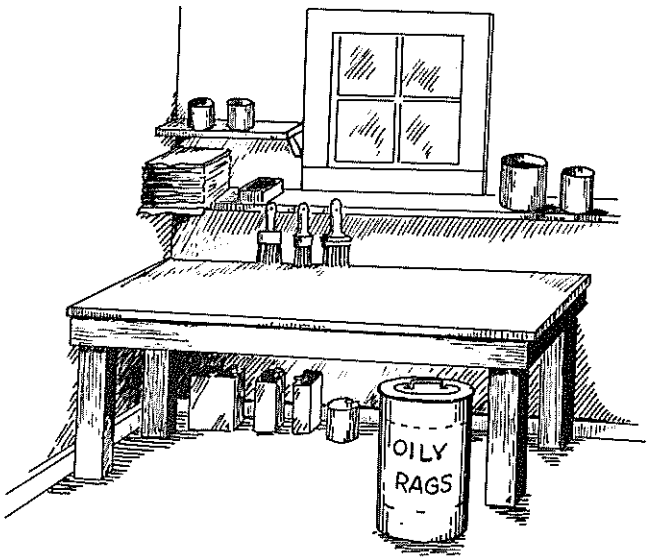


Fig. 14

SAFE STORAGE OF INFLAMMABLE MATERIALS

Old rags stored temporarily in metal pail in a well ventilated place and burned frequently in incinerator or fireplace. Papers neatly stacked on shelf. Gasoline and paint stored separately from rags. Spilled gas or oil wiped up frequently. Bottles should be stored in the shade. Cans are safer than bottles for storing inflammables.

POSSIBLE FIRE

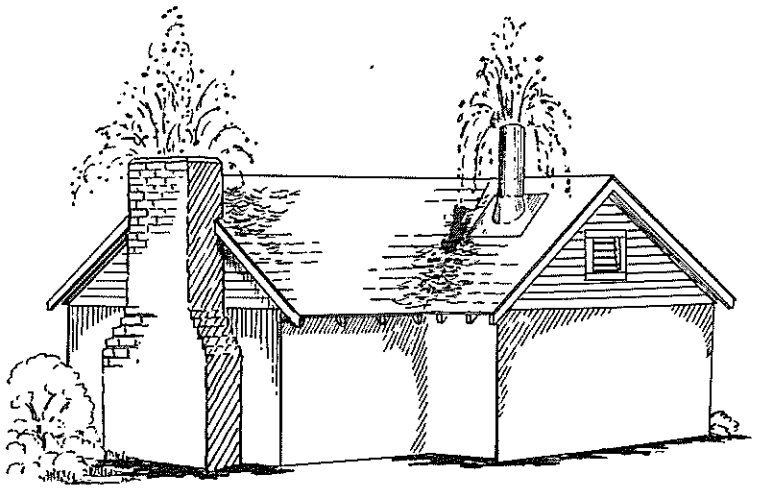


Fig. 15
UNSAFE CHIMNEYS AND ROOF
Sparks from stovepipe may ignite needles and leaves in roof gutter.

FIRE PREVENTED

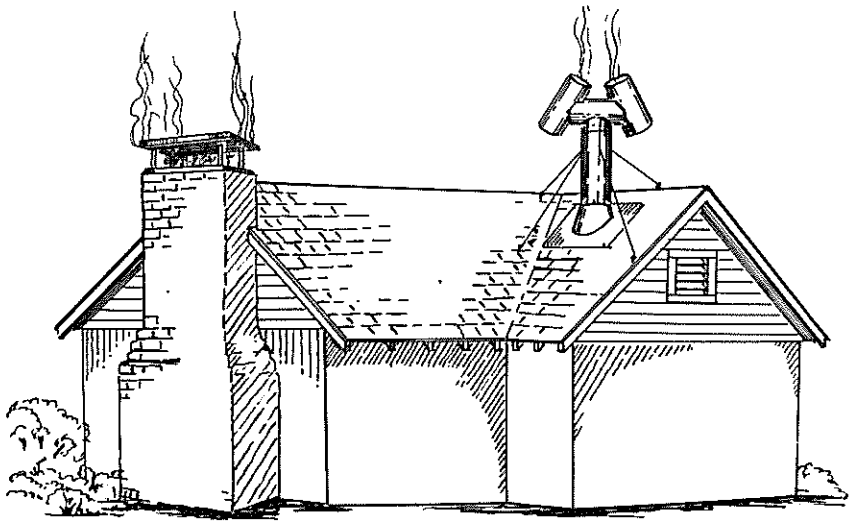


Fig. 16
SAFE CHIMNEYS AND ROOF
Needles cleared off. Stovepipe guyed, and fastened with screws. Stovepipe provided with approved spark arrestor.

POSSIBLE FIRE

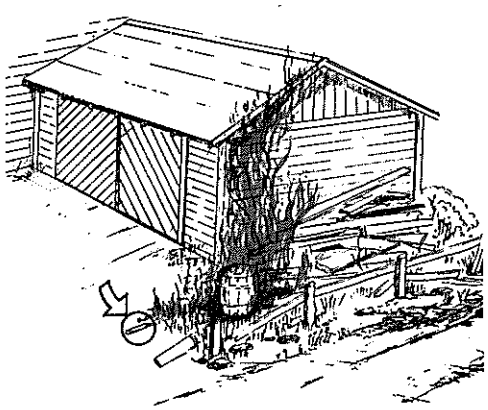


Fig. 17
INFLAMMABLE MATERIAL
AROUND BUILDING
A fire starting in grass can easily spread to a woodpile and building. A fire starting in building could easily spread to surrounding area.

FIRE PREVENTED

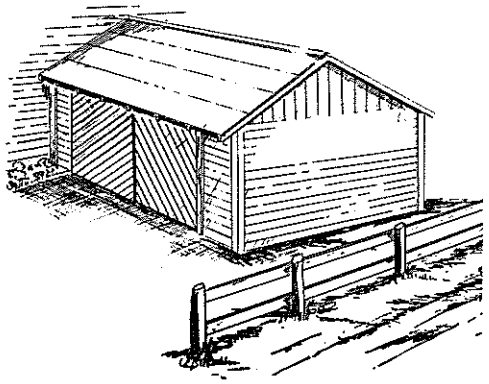


Fig. 18
INFLAMMABLE MATERIAL
AROUND BUILDING REMOVED
Fire goes out or can be stopped before reaching building. A fire starting in the building can be kept from spreading to surrounding area.

POSSIBLE FIRE

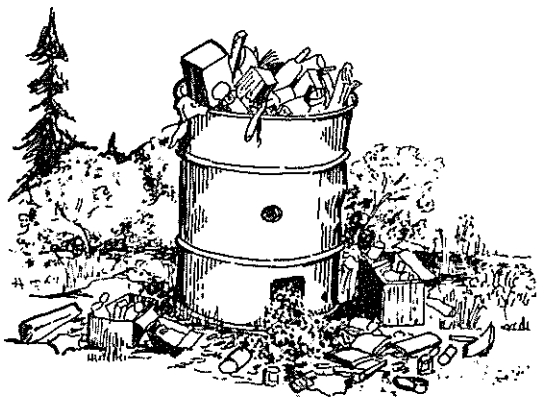


Fig. 19
UNSAFE INCINERATOR
Area not cleared of inflammable vegetation. Incinerator not fireproof - opening at top not screened. Debris allowed to accumulate (this fault may make even a safe installation dangerous).

FIRE PREVENTED

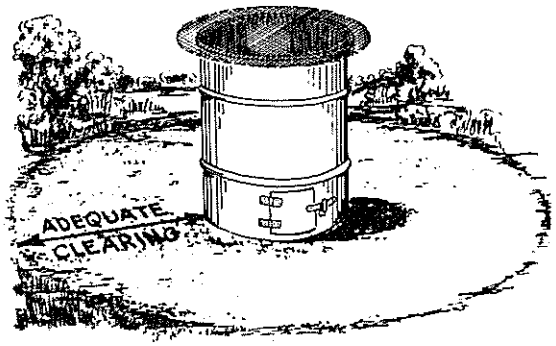


Fig. 20
SAFE INCINERATOR
Area cleaned up. Adequate clearance of grass and weeds. Top screened to prevent escape of fire. Debris burned currently. Someone in attendance while burning is done.

POSSIBLE FIRE

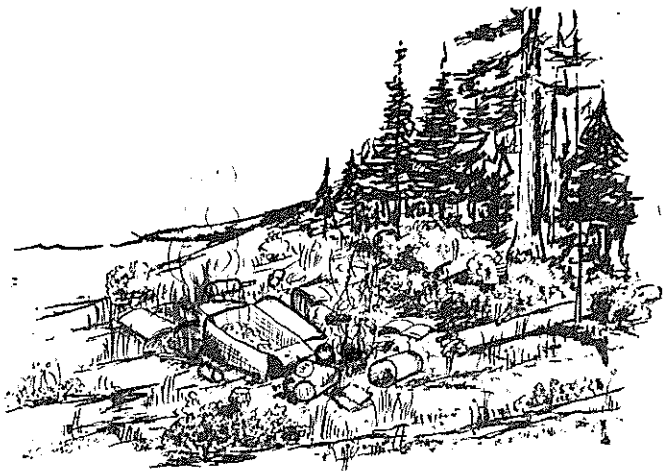


Fig. 21
UNSAFE GARBAGE DISPOSAL
Garbage often contains inflammable material which may be ignited by hot ashes, spontaneous ignition, or sunlight shining through glass. Fire can spread to grass and dry weeds at foot of brushy hill.

FIRE PREVENTED

Fig. 22
SAFE GARBAGE DISPOSAL
Area has a road or firebreak around it. Inflammable material has been cleared off, up to the road or firebreak. If fire should start in garbage, it will not spread.

POSSIBLE FIRE

Fig. 23
UNSAFE BURNING OF DEBRIS
No clearing between burning
pile and timbered area.

FIRE PREVENTED

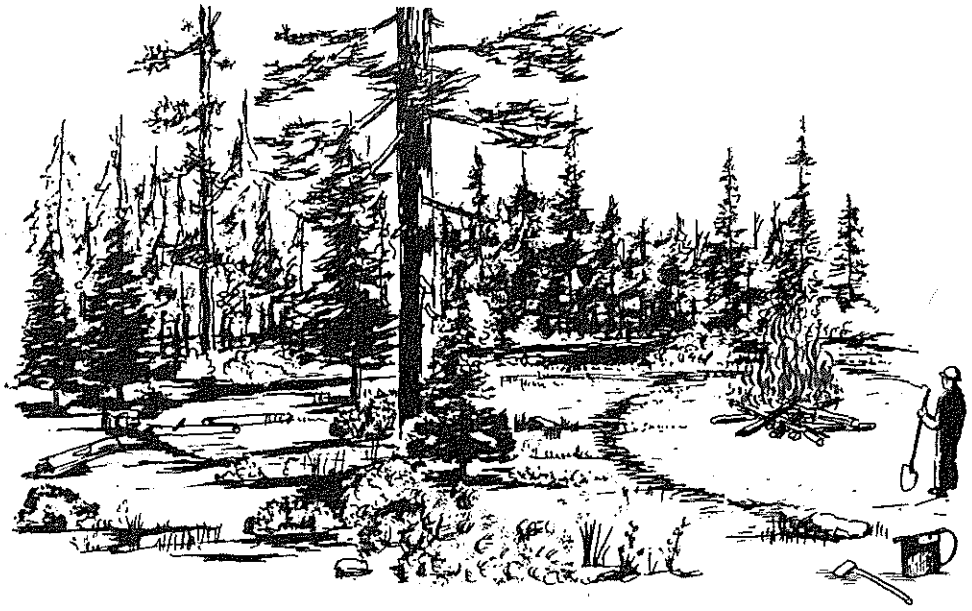


Fig. 24
SAFE BURNING OF DEBRIS
Debris is burned in cleared area
in an opening. Man in attendance
with shovel, axe, and water.

POSSIBLE FIRE

Fig. 25
UNSAFE DISPOSAL OF HOT ASHES
Ashes dumped directly on ground. Fire can spread in leaves, grass, or needles.

FIRE PREVENTED

Fig. 26
SAFE DISPOSAL OF HOT ASHES
Cool off ashes in covered metal container preferably partly filled with water before dumping.

POSSIBLE FIRE

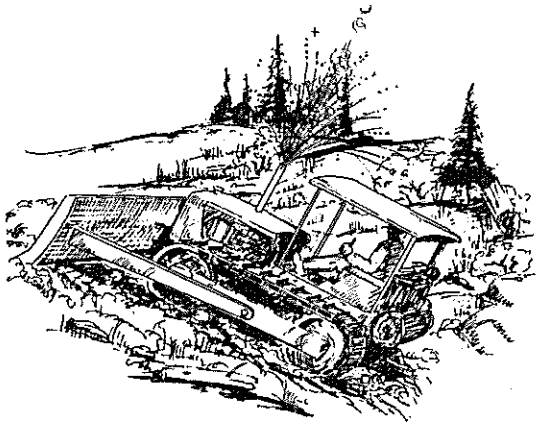


Fig. 27
TRACTOR WITHOUT SPARK ARRESTOR
Sparks land in grass or pine needles, starting fire.

FIRE PREVENTED

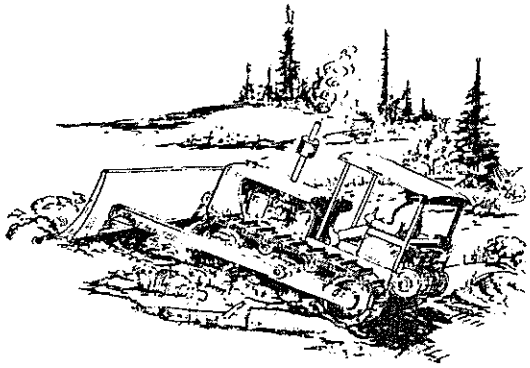


Fig. 28
TRACTOR WITH SPARK ARRESTOR INSTALLED
Hot carbon is trapped in spark arrestor - does not get out.

POSSIBLE FIRE

Fig. 29
WELDING WITHOUT REGARD FOR
NEARBY INFLAMMABLE VEGETATION
Sparks fall in inflammable vegetation or punky log and may start fire.

FIRE PREVENTED

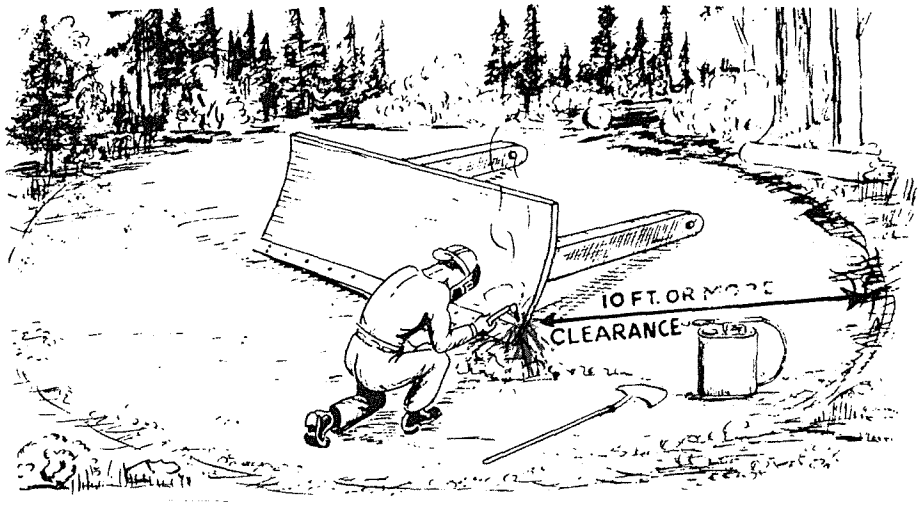


Fig. 30
WELDER SELECTS A CLEAR AREA OR
CLEARS AN AREA
Sparks and hot metal land on barren soil where they cannot start a fire. Shovel and backpack pump filled with water kept at hand in case a fire does start.

POSSIBLE FIRE

Fig. 31
FILLING SAW DANGEROUSLY
Saw is hot. Gasoline runs over and starts a fire. Saw being filled in unsafe location in midst of inflammable material.

FIRE PREVENTED

Fig. 32
FILLING SAW SAFELY
Saw being filled while cold. Care taken not to spill gas on motor. Saw being filled in roadway or other cleared area free of slash, needles, duff or other inflammable materials.

POSSIBLE FIRE

Fig. 33
CHOKER SETTER SMOKING UNSAFELY
Smoking in unsafe place. Hot coals can fall into pine needles. Smoking while working - therefore not paying attention to the risk.

FIRE PREVENTED

Fig. 34
CHOKER SETTER SMOKING SAFELY
Smoking in cleared area while waiting for tractor to return with next load of logs. Cigarette butt put out in mineral so soil.

POSSIBLE FIRE

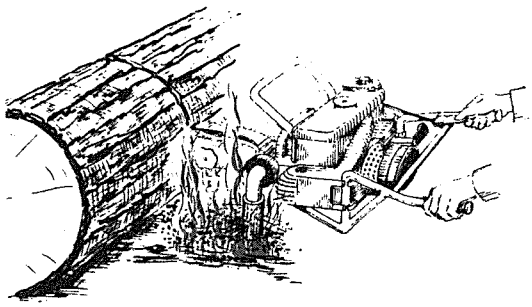


Fig. 35
UNSAFE TYPE OF POWER SAW
Chips pile up against hot muffler. Hot muffler contacts fuels on ground when saw is laid down.

FIRE PREVENTED

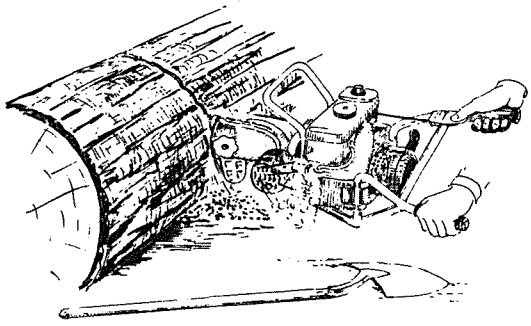


Fig. 36
SAFER TYPE OF POWER SAW
Designed so chips fall clear. Hot muffler is away from fuels, when saw is laid down.

POSSIBLE FIRE

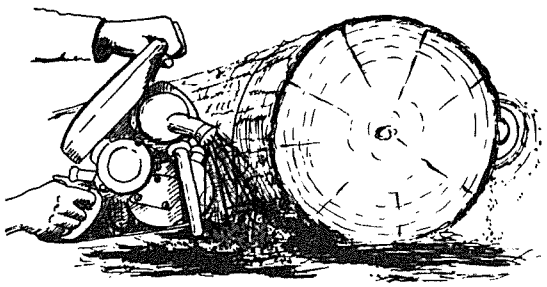


Fig. 37
UNSAFE OPERATION OF POWER SAW
Motor in poor condition, causing it to load up and then discharge hot carbon from exhaust. Position of muffler permits discharge of sparks into log or ground fuel. No shovel carried by operator.

FIRE PREVENTED

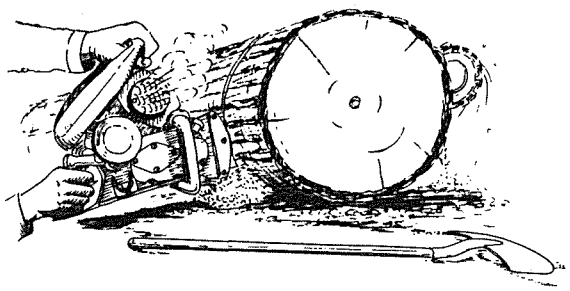


Fig. 38
SAFE OPERATION OF POWER SAW
Motor in good condition - nothing but gases come out of exhaust. Muffler located to discharge upward and outward away from fuel. Shovel carried by operator in case a fire does start.

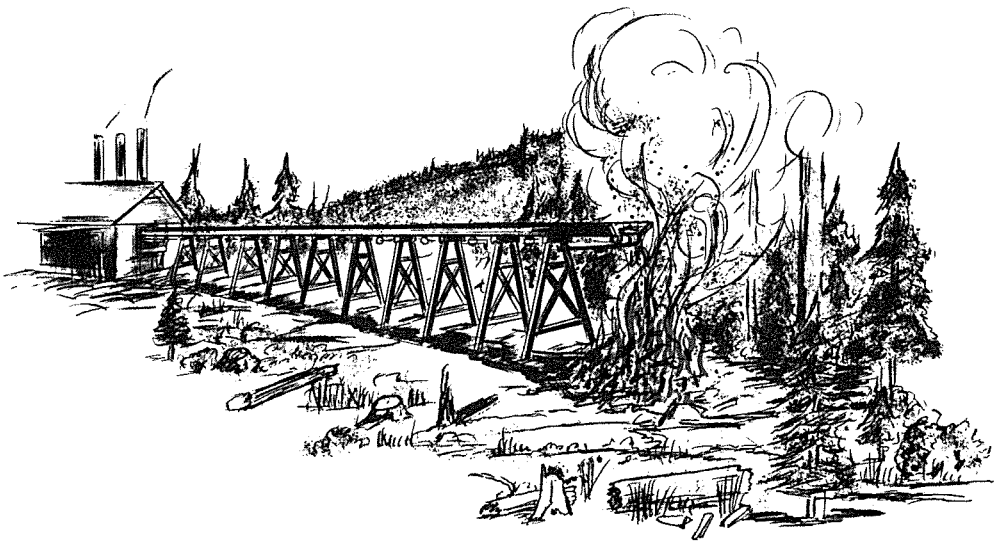


Fig. 39
UNSAFE DISPOSAL OF SAWMILL WASTE
Slabs and sawdust being burned in the open. Dry grass, needles, dead limbs, and snags nearby can carry fire into surrounding timber or back into the mill.

FIRE PREVENTED

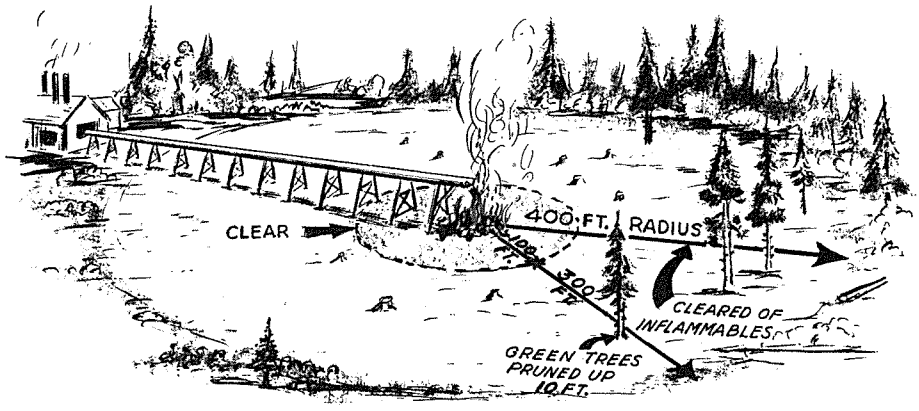


Fig. 40
BURNING MILL WASTE IN THE OPEN
Fireproofed clearing, 400-foot radius. Cleared of all inflammables - grass, needles, litter, slash, and snags. Living trees beyond 100 foot radius left standing, but branches pruned 10 feet high.

FIRE PREVENTED

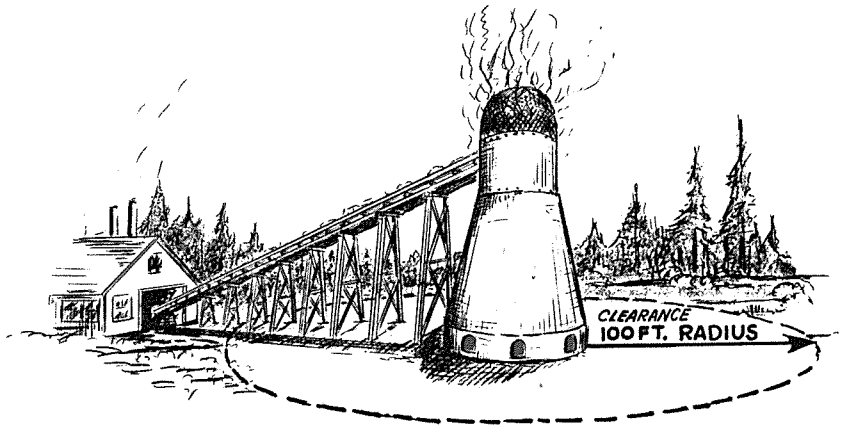


Fig. 41
BURNING SAWMILL WASTE IN ENCLOSED BURNER
Slabs and sawdust being burned in enclosed burner. All inflammable material removed for a distance of 100 feet.

HOW TO REMOVE HAZARDS AND CONTROL RISKS

REMOVING HAZARDS

Each hazard is likely to require a different approach. Some you will get cleaned up by persuading somebody else that it is to his interest to clean up the hazard (e.g., cabin hazards). Some you will get cleaned up by courteously explaining that there is a law which requires him to clean up the hazard. A great many hazards you will clean up yourself (such as hazardous camping places which may be used again). For some hazards (sawmill waste disposal) you may need the assistance of the Ranger or Fire Control Assistant.

CONTROLLING RISKS

Different risks require different approaches. To deal effectively with loggers, you must know something about logging. Personal acquaintance is very important.

The largest groups of forest users are the hunters, fishermen, and other recreationists. The effective approaches to them are signs and posters and talking with them personally about fire prevention.

The most effective fire prevention signs and posters are those that make use of Smokey Bear. Smokey is the trademark of the National Cooperative Forest Fire Prevention Campaign. The United States Forest Service, State Forestry organizations, and other public and private organizations interested in forest fire prevention, all participate in this campaign.

Smokey is known to millions. His value ranks in the class with internationally known advertising slogans and trademarks. In the city streetcars and the rural postoffices, Smokey has told people why to prevent forest fires. When folks get into the woods, Smokey's job is to tell them how to prevent fires.

There are two types of Smokey Bear signs - those that tell why to prevent fires and those that tell how. You should display the why signs in town. The how signs should be posted in the forest -- at campgrounds, along roads and trails, and on fishing streams. These are the places where people use fire and need to know how to use it safely.

Talk about fire prevention should be specific. Tell folks to do it "this way". Show them how. And remember to cooperate with other fire control agencies. Point out that good fire prevention is good in anybody's woods.

Everyone who builds a campfire on national forest land must have a Campfire Permit. The biggest advantage of this regulation is that it gives you a chance to tell a great many people why and how to prevent forest fires. Take advantage of every one of these opportunities and do a good job every time.

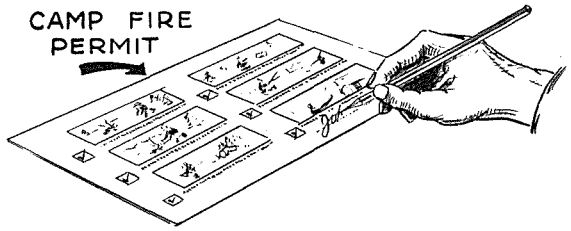
At times, and in some areas, the fire prevention problem is so serious that it cannot be solved by ordinary methods of controlling hazards or reducing risks. These occasions are rare. When they do occur, the portion of the national forest concerned may be closed until the fire danger has lessened. This is called a "closure". It is made at the request of the Forest Supervisor. The approval of the Regional Forester is necessary to put a closure into effect.

Remember- **Only you can**

PREVENT FOREST FIRES!

PROBLEMS IN FIRE PREVENTION

PROBLEM 1: HOW TO ISSUE A CAMPFIRE PERMIT



POINT 1. HOW TO PREVENT FOREST FIRES
POINT 2. WHY TO PREVENT FOREST FIRES

Fig. 42

Condition

Deer hunter stops at your station and asks for a Campfire Permit.

Action Required

1. Politely ask the hunter if he knows the laws regarding smoking and campfires.
2. Review these laws very briefly, giving reasons for each.
3. Make out Campfire Permit, turn it over and review printed stipulations with hunter, checking them off one at a time. Ask hunter if he agrees to abide by these. Hunter agrees. Have him sign permit and take it with him.

Why (numbers which follow correspond to numbers above)

1. You size up your "customer" by letting him talk. You have learned what the hunter knows about fire and smoking regulations.
2. The main purpose of the permit is to give you a chance to tell people how and why to prevent forest fires.
3. When the hunter signs the permit, he has signed a "contract" to abide by the fire regulations.

Supplemental Action

Hunter may reply that he does know these laws, but you should review them with him just the same. There may be other good ways to issue a Campfire Permit. Also, the best method with one person may not be the best with another. But always get these two points across:

1. How to prevent forest fires.
2. Why to prevent forest fires.

PROBLEM 2: HOW TO BUILD AN OPEN CAMPFIRE

NOTE: On some national forests in the California Region, open campfires are prohibited, and campfires or picnic fires can be built only in camp stoves in improved campgrounds. In some forests open campfires are prohibited only in certain portions of the forests. Other forests permit open campfires provided they are built in a safe place according to the rules of the Campfire Permit which the camper must first obtain. Find out from your Ranger what the rules for campfires are in your district.

Fig. 43

Condition

You are on fire prevention patrol in an area where open campfires are permitted. You notice a car which has stopped in an area suitable for camping and the family appears to be setting up camp, but no campfire has been started.

Action Required

In your conversation with the people, the man mentions that they obtained a Campfire Permit which he shows you. He says they have not camped out before and would like your help in selecting a safe to build their campfire.

Tell him that you appreciate his desire to build a fire which will be absolutely safe, and since he has not built an open fire before, you will be glad to show him how it can be done easily.

1. Select a shaded location away from heavy fuels such as logs (especially punky logs), brush, or heavy duff and needles.
2. Use shovel to clear an area at least 10 feet in diameter. Scrape away all grass or needles and duff down to mineral soil.
3. Scoop a depression in the center of the cleared area in which to build the fire and put a ring of rocks around it.
4. Cut some wood in short lengths and light the fire, explaining that the fire should be built no larger than necessary.
5. Explain that the fire should not be left unattended and that it should be extinguished completely with water and earth when everyone leaves camp.

Why

As you build the campfire explain the reason for each of the above points.

1. To prevent the flame or sparks from igniting adjacent or overhead fuels.
2. To prevent fire from creeping or smoldering into adjacent fuels.
3. To shield fire and sparks from wind -- also to make the fire easier to extinguish.
4. A large campfire just increases any possible danger of spreading, and it is harder to extinguish.
5. Fire might escape while no one is in attendance.

Supplemental Action

Although shovel and axe are not mandatory, urge campers to equip themselves with these tools. They are needed to clear the ground adequately for the campfire and to cut wood. Also, the tools could be used to extinguish any fire the campers might discover. Mention other points of the Campfire Permit as the opportunity presents itself -- smoking rules, disposal of refuse, fish and game rules.

PROBLEM 3: HOW TO COMPLETELY EXTINGUISH AN OPEN CAMPFIRE

Condition

While visiting a camp you observe a camper packing equipment in automobile as if to leave camp. Camper empties coffee pot on his open campfire without stirring fire.

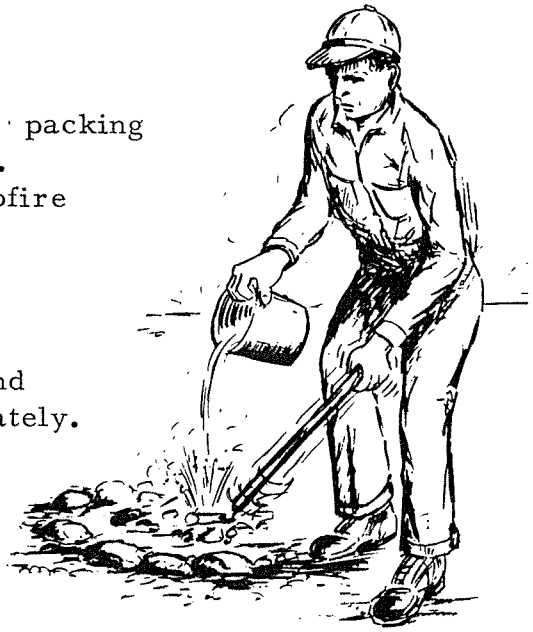


Fig. 44

Action Required

Approach camper in a friendly manner. Find out if he is intending to leave camp immediately. Explain the danger of leaving a campfire without being certain it is completely out - dead out! Show camper how to put the fire completely out.

1. Fill camper's bucket with water and pour it on his campfire while you completely stir and wet all of the ashes. Turn wood and coals over and wet all sides.
2. Move some of the dirt immediately adjacent to the fire into the fire and mix thoroughly.
3. Feel with your hand all around fire to be sure nothing is still smoldering.
4. Make an adequate clearance to mineral soil around the fire, explaining that if any ember has been missed, it cannot smolder through the soil as it might through the duff, into fuel around the camp.

Supplemental Action

Explain to camper that if no water had been available, the fire could still have been put out completely with dirt.

1. Mix the dirt immediately adjacent to the fire into the fire. Mix thoroughly with the ashes and coals.
2. Use shovel to scrape the coals or smoldering embers from any partially burned wood in the fire.
3. Dig some cool damp dirt from adjacent area and mix two or three shovelfulls into the coals and ashes. Mix thoroughly and rub the scraped wood into the dirt.

4. Wait a short while and thoroughly stir again.
5. Be sure there is adequate clearance to mineral soil around the fire and feel with hand to be sure no hot material has been missed.

PROBLEM 4: WHAT TO DO ABOUT A PARTY CAMPED IN A HAZARDOUS LOCATION

Condition

Camper is present. Fire built near thick reproduction; entire area densely wooded. Adequate clearing not possible because of deep duff and rocks. Camper has Campfire Permit.

Action Required

Approach camper in a friendly manner. Determine extent of camper's knowledge of safe use of fire. Explain dangerous aspects of situation. Convince him of need to move to an improved campground or other safe location. Point out requirements of Campfire Permit and assist him in putting fire completely out. Advise him where he can find a safe camping location.

Why

This action will prevent the fire from spreading beyond control. This approach is used to get the camp moved to a safe place, and at the same time encourages a cooperative relationship.

Supplemental Action

1. You should visit the newly located camp later that day or the next day.

2. If there is a safe spot in the area, it will not be necessary to move the camp; move only the campfire.

PROBLEM 5: HOW TO PREVENT FIRES CAUSED BY DUMPING HOT ASHES

Condition

You arrive at a residence in the forest and during the conversation with the housewife, discover that she has been dumping ashes from the stove back of the house near some dry grass.

Fig. 45

Action Required

Point out to the housewife that there may be hot coals in the ashes which might set the dry grass on fire and burn down her house. Also explain how ashes can stay hot a long time and how wind can fan coals into flame and cause the fire to spread rapidly. Show her how to put ashes in a metal container to cool before dumping. Assist her by actually clearing the grass from the area for a safe distance.

Why

Positive action is necessary - wind may blow today - you cannot depend on resident to take action on instruction alone. Your immediate personal interest impresses the resident with importance of the matter.

Supplemental Action

Same situation and type of action applies to incinerator, barbecue pit, or campfire.

PROBLEM 6: UNSAFE INCINERATOR

Condition

You are making a prevention visit at a mountain residence where a 55-gallon drum is used as an incinerator. The incinerator is near steep slope which is covered with brush, grass, and leaves. There is no screen on drum, which has already been used to burn papers and debris. Owner is present.

Action Required

Discuss problem with owner. Point out fact that burning permit is required for burning any inflammable material within 100 feet of grass, brush, or forested area. Advise him that no permit will be issued unless the burning is safe. Show him how to make the incinerator and the area around it safe by clearing away trash and leaves. Also tell him that screen must be provided for the top of incinerator. Caution the owner not to use incinerator until required changes are made and burning permit is issued to him. Point out his liability and responsibility if his burning does cause a fire. Someone must be present when burning is done.

Why

Action must be taken to prevent possible serious fire. Burning permit required by law; and he should not be issued a permit until his incinerator is completely safe.

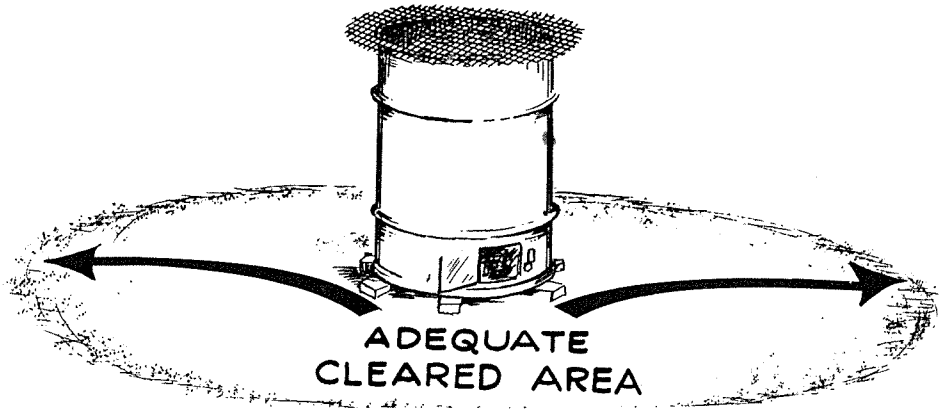


Fig. 46

Supplemental Action

Assist the occupant in getting a burning permit and inspect the incinerator again on next trip.

PROBLEM 7: CHILDREN PLAYING WITH MATCHES

Fig. 47

Condition

A group of small children playing near the road seem to be stacking needles and litter for a bonfire. You stop to investigate, and find a small pile of needles has been burned and another pile stacked ready for lighting.

Action Required

Talk quietly with children. Find out what they were doing and the names of all children involved. Ask children for the matches. With matches in your possession, visit the parents of all children involved and stress the importance of keeping matches out of reach of children and the responsibility of the parents for their children's actions. Carry your campaign to parents of children throughout the area.

Why

Always investigate suspicious actions. Take matches as insurance measure and as proof to parents. Work through parents as they are responsible for the action of their children and can apply appropriate disciplinary action.

Supplemental Action

Report the facts to Ranger so that the case may be made a matter of record for future reference.

PROBLEM 8: WELDING IN DANGEROUS AREA

Condition

Tractor has broken down in a brush area while pushing a log. Mechanic is welding with acetylene torch. No clearing where work is being done. No water or shovel available to put out fires started from sparks.

Action Required

You look over the situation. Have mechanic stop welding. Explain that certain precautions are required by State Law when doing this type of work. With mechanic, make an inch by inch inspection of the area within a reasonable distance of the work and extinguish any fires found. Help mechanic clear an area at least 10 feet back from work. Have him get a backpack pump filled with water to put out fires that may occur. Notify Ranger or Fire Control Assistant of action taken.

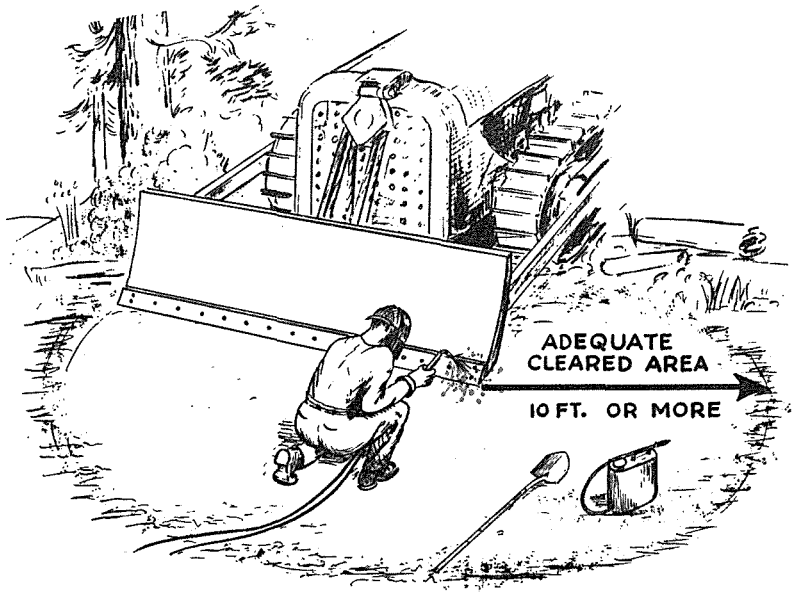


Fig. 48

Why

To eliminate potential danger of fire starting and teach mechanic proper fire prevention measures.

Supplemental Action

Good compliance with law is often gained by advising Woods Boss or Construction Superintendent of violation, and explaining company liability if a serious fire should result.

PROBLEM 9: FOREST RESIDENT PLANNING TO BURN TRASH WITHOUT A PERMIT

Condition

You are approached by a rancher who tells you he has a pile of rubbish that he intends to burn tomorrow morning before leaving for work. Rancher requests that you notify the Lookout. Rancher has no burning permit.

Action Required

Fig. 49

Explain to rancher that he must first secure a burning permit. Inform him where and from whom he can obtain it. Also tell him he must plan to stay with the fire until it is out. Then secure information as to amount of rubbish, location in relation to forest cover, and report the matter to Ranger or Fire Control Assistant.

Why

To prevent the rancher from committing illegal and unsafe burning. You may not have authority to issue permit, but can assist rancher in securing one.

PROBLEM 10: UNIMPROVED FISHERMAN CAMP IN HAZARDOUS LOCATION

Condition

Frequently used camping spot near a stream; accessible by narrow road or trail. Rock fireplace located at base of brush covered slope. Camp not in use when you arrive.

Action Required

Move fireplace to safe spot near stream (considering shade). Also move some ashes to give the impression that it has been used in this location. Bury remaining ashes and eradicate other evidence of fire in previous location. Scrape fire line around edge of camping spot. Post sign, "Drown your campfire with water", near the fireplace. Post prevention sign on road or trail.

Fig. 50

Why

Campers usually use existing fireplace. The right sign in the right place is important.

Supplemental Action

If the camping spot is in an area where campfires are prohibited, throw rocks in the creek, bury the ashes, and post a sign, "No campfires allowed".

PROBLEM 11: INSPECTION OF A COUNTRY STORE

Condition

You are on routine inspection and stop at local store on private land. Quick size-up indicates two small cabins which are rented to fishermen. Accumulation of rubbish and general condition hazardous. Incinerator in dangerous place.

Action Required

Use the incinerator as an approach. Point out danger and suggest remedy. Help owner move it to a safe spot. Use this as an opening to suggest looking over the whole place. Use residence inspection check list. Record all dangerous situations and suggest action. Leave a copy with owner.

Fig. 51

Why

Approach must be in a cooperative and helpful spirit. Sell him on the idea that you are saving him trouble and possible loss of property.

Supplemental Action

The above approach, after several tries, may not produce results. It can then be pointed out to the storekeeper that State Law requires each landowner to do all he can to prevent escape of fire to the property of his neighbor. If he allows such a mess to accumulate, he is certainly not doing all he can in this respect.

PRACTICE WHAT YOU PREACH!

We of the Forest Service must set an example for good fire prevention practices in all that we do. We must observe the smoking regulations - our incinerators must be safe - the hazard reduction around our buildings must be complete before we can expect these things of other forest users.

REVIEW QUESTIONS - FIRE PREVENTION

1. What are risks and hazards? Give two examples of each.

2. When a risk is combined with a hazard, what is likely to happen?

3. Fill in the blanks in the following statement:
"To prevent fires, we must _____ the risk or _____ the hazard."

4. Following are some unsafe practices and conditions which are likely to cause forest fires. For each one, describe briefly an alternative practice and condition which is safe (as per examples).

UNSAFE PRACTICES OR CONDITIONS	SAFE PRACTICES OR CONDITIONS
a. Smoking on horseback.	a. Stop at stream crossing and smoke there.
b. Incinerator with open top.	b. Screened incinerator.
c. Putting out cigarette on punky log.	c.
d. Campfire built alongside log.	d.
e. Stove ashes dumped on ground.	e.
f. Pine needles on roof.	f.
g. Oily rags piled in corner of room.	g.
h. Dumping of garbage along road.	h.
i. Hot carbon escaping from tractor exhaust.	i.
j. Hot carbon escaping from power exhaust.	j.
k. Filling power saw gas tank in the brush.	k.
l. Choker setter or other logger smoking while working.	l.

5. Give one example of a hazard which you might remove yourself. Name one which you should get somebody else to remove.

6. "Smokey Bear" pictures are displayed both in the cities and in the forest. In the city, Smokey, for the most part, teaches people why to prevent forest fires. What should he teach them when he meets them out in the forest?

7. Is the U. S. Forest Service the only organization which is interested in Forest Fire prevention?

8. Who else do you think is interested? Why?

9. What is the main purpose of the Campfire Permit?

10. What should be done about a party that is camped in a location which is hazardous and cannot be readily cleaned up?

11. Rancher or other forest resident plans to burn rubbish. Fireman not authorized to issue burning permits. Fireman tells him he must have permit. What else does he tell him about permit?

LAW ENFORCEMENT

OBJECTIVE

The primary objective of fire law enforcement is to prevent fires. It will best accomplish this purpose when handled firmly, with courtesy and impartiality.

LAWS AND REGULATIONS WHICH APPLY

Fire Law Enforcement Is Based On

1. Federal Fire Laws and the Regulations of the Secretary of Agriculture.
2. California State Fire Laws.
3. County Fire Ordinances.

Where These Laws Can Be Enforced

1. The Federal Fire Laws can be enforced on any U. S. Government land. The Regulations of the Secretary of Agriculture can be enforced only on national forest lands.
2. State Fire Laws can be enforced throughout the State of California (on private land and U. S. Government land, including national forest lands).
3. County Ordinances can be enforced only in the particular county in which they were passed.

Who Is Authorized To Enforce Fire Laws

1. Federal Laws and Regulations of the Secretary of Agriculture can be enforced by all Forest Service Officers.
2. State Fire Laws can be enforced by those Forest Service Officers who have been personally appointed as Voluntary State Fire Wardens by the State Forester.
3. County Fire Ordinances can be enforced by Voluntary State Fire Wardens, Peace Officers, and any others specifically named by the ordinance.

Your Letter of Instructions will specify your law enforcement authority.

Where To Find The Fire Laws

1. The Federal Fire Laws and the Regulations of the Secretary of Agriculture are listed in the "Law Enforcement Handbook" Region 5.
2. The California Fire Laws are listed in "California Forest and Fire Laws" published by the Department of Natural Resources, Division of Forestry, Sacramento, California. A brief of the more important State Fire Laws and Regulations will be found at the end of this chapter.
3. Copies of County Fire Ordinances in force in your area will be furnished you by your District Ranger.

THE DIFFERENCE BETWEEN MISDEMEANORS AND FELONIES

Misdemeanors

Most of the offenses or violations with which you will be concerned are classed as misdemeanors.

Violations of all of the Fire Regulations of the Secretary of Agriculture (with the exception of the closure regulation) are misdemeanors and are punishable by a maximum fine of $1,000 or by imprisonment in a jail not exceeding one year, or both. (Violation of the regulation on Forest closures is a petty offense with a maximum fine of $500.00.)

Violations of most of the State Fire Laws and all County Ordinances are misdemeanors and are punishable by a maximum fine of $500 or by imprisonment in a county jail not to exceed six months, or both.

Examples Of A Few Misdemeanors

1. Leaving a campfire unattended.
2. Smoking in a closed area.
3. Burning without a permit.

Felonies

Felonies are more serious offenses and carry greater penalties. They are punishable by imprisonment in a State or Federal Prison for terms exceeding one year.

If you have occasion to participate in the investigation of a felony violation, get the advice of your District Ranger or Fire Control Assistant.

Trained law enforcement officers are available to assist in the action. Your job in this case is to secure all the information possible. (See "Action in Cases not Witnessed nor Admitted.")

Violations of some of the Federal Fire Laws and a few of the State Fire Laws are felonies.

Examples of felonies are:

1. Willful setting of fires on National Forest Land. (A Federal Fire Law)
2. Setting fire to a building with intent to destroy. (A State Fire Law)

FIREMAN'S ACTION IN CONNECTION WITH VIOLATIONS

Notice of Violation:

Form 13a-R-5, Notice of Violation, is an aid in fire prevention and the enforcement of County, State, or Federal fire laws. Its issuance does not constitute an arrest. It simply identifies the supposed violator for future reference in case the reviewing officer decides a law enforcement case exists. If no further action is taken, it effects fire prevention in the form of a warning. This form is issued in duplicate. The original is kept for the reviewing officer and the copy is issued to the violator.

Form 13a—R. 5

NOTICE OF VIOLATION

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

_____ NATIONAL FOREST, _____ 19____

NAME _____ ADDRESS _____

AUTOMOBILE _____ _____ _____
LICENSE NO. STATE MAKE

IDENTIFICATION _____
DRAFT REG. NO., OPER. LICENSE NO., SOCIAL SECURITY, ETC.

VIOLATION _____ LOCATION _____

REMARKS _____

_____ _____
SIGNATURE OF VIOLATOR (IDENTIFICATION) FOREST OFFICER

THIS NOTICE IS GIVEN IN THE CAUSE OF FIRE PREVENTION AND IS TO INFORM YOU OF A VIOLATION OF FOREST LAW, WHICH WILL BE REFERRED TO PROPER AUTHORITIES FOR DISPOSITION.

(OVER)

Fig. 52

Action In Cases Witnessed Or Admitted

If you have actually witnessed a violation or a person has admitted the offense, do the following things:

1. Issue a Notice of Violation, filling out the "identification" item in detail.
2. Secure the violator's signature on the notice.
3. Find out how and where he can be reached for further questioning.
4. Report the matter without delay to your District Ranger or Fire Control Assistant for follow-up.

If the violator refuses to sign or to remain available, you still issue the notice and report the violation. If your description of the man, his clothing, his car, and his equipment are complete and you report the matter without delay, he can be found later.

Action In Cases Not Witnessed Nor Admitted

In such a case you are primarily an investigating officer and your job is to investigate the offense. This means collect and record evidence, get the name of offenders, secure witness statements, describe the offense as a basis for obtaining a complaint and warrant, and get any other information that will help connect the offense with the party responsible.

Investigation Of Man-caused Fires

Investigations of man-caused fires, to be successful, must be made at the earliest possible moment. Since you may be the first man to arrive at the fire, both suppression and law enforcement will depend upon your actions. Your responsibility for investigation is second only to the suppression of the fire. Oftentimes, the two jobs may be carried on at the same time. Your primary job in an investigation for law enforcement is to secure all the information and evidence possible.

How To Do It!

1. Enroute to the fire:

    a. Make note of anyone you meet whom you might suspect as having had something to do with starting the fire. Record license number and description of auto, number of people and personal descriptions.

b. Look for tracks or other clues on the trail to the fire or in the vicinity of the fire. (Foot, horse or automobile.)

c. Preserve or protect any tracks or clues seen for future reference.

Fig. 53

d. Protect tracks by blocking off or covering with logs, brush, or limbs.

2. As you approach the vicinity of the fire:

   a. Determine point of origin from wind direction and direction the fire has spread.

   b. Cover any tracks in vicinity of point of origin.

   c. Keep other firefighters away from point of origin except as necessary for control of fire.

3. As you make your attack:

   Keep on the lookout for evidence of how fire started and who was responsible. Examples of evidence are: campfire remains, matches, cigarette butts, lunch remains, scraps of paper, newspaper, bottles, or store receipts (or anything indicating identity of individuals). If you find evidence that looks important, try to get word to your Dispatcher as soon as possible by radio. Protect any evidence found until you have time to pick it up for preservation. Handle each item carefully in order not to destroy fingerprints.

4. After control of fire, or sooner, if you can be spared from the control jobs:

   a. Continue to look for clues.
   b. Collect clues, being careful to preserve them for evidence. If small, they can be preserved in match box or envelope. Record time, place found, and your initials on all clues collected.

5. Prepare a map of the fire area, showing point of origin and locations of clues found.

6. Record (so you will not forget) all information obtained, names of anyone seen or contacted, and any conversations.

7. Secure statements from witness or any other individual who may be connected in any way. These statements need not be elaborate, but should be complete as to detail, and should be secured as soon as possible. If the statement is obtained at the scene of the fire, it would necessarily be handwritten and might be written on a piece of notebook paper. (See Figure 54.)

Hay fork, Calif. July 11, 1954

I, Howard Jones, of 729 Maple St., Sacramento, Calif., was returning from fishing on Cripple Creek. At about 3 P.M. I met two men walking along the trail about a mile before I came to the fire. These men had a pick, shovels and a gold pan, so I assumed they were going to the gold mine located down the stream. Both men appeared to be about 50 or 55 years of age. One of them was about 6 feet tall and wore a black and red checked shirt. The other man was shorter and walked with a limp.

Howard E. Jones

(witness to signature)

James K. Lane, Fire Control Asst. Hayfork Ranger Station

Fig. 54

Sample Witness Statement

PROBLEM 1: HOW TO HANDLE A MISDEMEANOR VIOLATION WHICH HAS BEEN WITNESSED OR ADMITTED

Condition

You find a campfire burning in camp along a canyon road. Also an automobile and camp gear, but no persons are in camp.

Action Required

You make sure that fire will not escape, then note name of car owner, make of car and license number. After a short wait, a man comes into camp with a string of fish. Secure man's name, which is the same as that given on the car registration certificate. Ask him for his campfire permit, and have him read it aloud. Point out to him firmly, but courteously, that he has violated the law in leaving his campfire unattended. Issue Notice of Violation; find out when he plans to break camp and where he is going; tell him the District Ranger will determine law enforcement action to be taken and encourage him to see the District Ranger before he leaves the area. You report as soon as possible to District Ranger, giving him copy of Notice of Violation and explain circumstances. Ranger then reviews case and takes necessary action.

Why

Law has been violated and action is required. Notice of Violation is issued which protects inexperienced patrolman or fireman who might become involved in false arrest claims if citation were issued without cause. Ranger can act on Notice of Violation and secure appearance of the violator in court.

Supplemental Action

If violator is leaving, arrange for him to meet District Ranger on his way out of area.

PROBLEM 2: HOW INITIAL ATTACK FIREMAN CAN HELP INTERCEPT PARTY LEAVING VICINITY OF FIRE

Condition

You are enroute to a fire; you meet a car traveling rapidly away from fire.

Action Taken

You note make and color of car, and attempt to get license number. Radio information to Dispatcher immediately. Continue on to fire.

Why

So that someone can be sent to intercept the car before it gets out of the area.

Supplemental Action

If you have no radio, record the information in your notebook and pass the information on to the Dispatcher as soon as possible so suppression action on the fire can get started. If circumstances permit stopping car without undue delay or safety hazard, this may be done in order to get information.

PROBLEM 3: HOW TO PRESERVE CLUES

Condition

Enroute to a fire, initial attack fireman sees fresh foot tracks in trail, leading from fire.

Action Taken

Blocks enough of trail to preserve several prints. Leaves a note for reinforcements to detour around tracks. Continues to fire.

Why

To preserve footprints for later investigation. (See Fig. 53)

Supplemental Action

Same action should be taken to preserve any evidence found at scene of fire.

PROBLEM 4: HOW TO INVESTIGATE WITHOUT DELAYING INITIAL ACTION

Condition

You arrive in vicinity of a fire on initial attack with 4-man crew. Fire has burned out along small flat near road, but is burning up the slope. You size up fire from vantage point; decide to attack fire at the head.

Action Required

Instruct crew to approach fire from the flank and stay away from rear (point of origin).

Why

To preserve any clues that may be at point of origin. No control action required near point of origin.

Supplemental Action

If control action is necessary near point of origin, disturb area as little as possible and watch for clues. If you can be spared from control action, look for and preserve clues.

SUMMARY OF STATE OF CALIFORNIA FIRE LAWS

It is unlawful to:

1. Allow any fire kindled by any person to escape and spread to the lands of another person.

2. Throw or place any lighted tobacco, ashes, or other flaming or glowing material where it might start a fire.

3. Use a welding torch or tar pot without clearing inflammable material surrounding the operation for a reasonable distance (at least 10 feet) and without maintaining one shovel and one backpack pump ready for use.

4. Throw from a moving vehicle any lighted tobacco or flaming or glowing substance.

5. Use a logging locomotive, donkey or threshing engine, or any engine or boiler on forested lands without an adequate device to prevent the escape of fire or sparks.

6. Operate any gas or oil-burning tractor, truck, or auto without attaching to the exhaust an effective device or exhaust pipe for arresting burning carbon and sparks, or without a shovel if engaged in logging operation.

7. Use a gasoline-powered saw within 50 feet of any inflammable material on any forested or brush-covered land without providing one serviceable fire extinguisher or shovel.

8. Refuse to fight fire, when asked by State Fire Warden.

9. Forbid, prevent, or dissuade others from assisting to extinguish a fire.

10. Maliciously and wilfully set fire to a house, barn, stable, or out-house with intent to destroy - (a felony).

11. Wilfully and maliciously burn growing or standing grass, forest, brush, or slashings on property of another - (a felony).

12. Build fires upon lands of another without a permit from the landowner.

13. To light, maintain or use a campfire on property of another in brush, grass, or forest-covered land without written permit from the owner - or on national forest lands without a written Campfire Permit.

14. Allow a campfire to spread or leave an unattended campfire burning.

15. Smoke or build campfires within an area closed to smoking or camping.

16. Burn brush, slash, or refuse without a written permit any time between April 15 and December 1 of any year.

17. Use explosives without a permit between April 15 and December 1 of any year.

18. Possess or fire tracer bullets on forest or brush-covered land.

19. Discharge dangerous fireworks any place without a permit.

20. Manufacture or sell dangerous fireworks without a permit.

21. Make a public display of fireworks without a permit.

REVIEW QUESTIONS -LAW ENFORCEMENT

1. What is the primary job of the fireman in connection with Law Enforcement?

2. Under what circumstances does the fireman issue a Notice of Violation?

3. What action should the fireman take when he has reason to suspect that someone has wilfully set fire to National Forest land.?

4. Why is it important that the fireman look for and preserve clues while enroute to a fire?

5. Name three ways by which a fireman can help investigate the cause of a fire and still make rapid, effective initial attack.

6. How are clues, such as footprints and car tracks, easily preserved?

7. What three items should be recorded when marking clues for future identification?

8. Why should you report clues to your Dispatcher or District Ranger as soon as possible?

9. Why is it important to record, in your diary or notebook, any clues or information you discover?

PREPAREDNESS

INTRODUCTION

Effective initial attack action on fires is not accomplished by accident. It is the result of advance preparation of all fire forces who are in top condition and ready to go at a moment's notice. Fast action requires that you:

Have all your fire gear ready at all times.
Know exactly where you are going and how to get there.
Get there safely and early with the right equipment.
Hit fires HARD while SMALL.

STANDARDS OF PREPAREDNESS

Elapsed Time Standards

In all phases of fire control work, speed - with safety - is essential. Generally the longer a fire burns the larger the fire becomes. Consequently the job of controlling it becomes larger and more difficult. We must do every job in fire control in as short a period of time as possible. Fires should be:

discovered as soon as possible,
attacked as early as possible, and
controlled as quickly as possible.

Goals have been set for the maximum amount of time allowable for each step of the fire suppression job. We call these goals ELAPSED TIME STANDARDS. Those established for initial attack forces are as follows:

Elapsed Time Standards For Initial Attack Forces

(1) Discovery

As soon as possible

(2) Report to Dispatcher

(A) Forest Service telephone lines or Radio	2 minutes
(B) Lines other than Forest Service	5 minutes

(3) Report (Dispatcher to Fireman)

(A) Forest Service Lines or Radio	2 minutes
(B) Lines other than Forest Service	5 minutes

(4) Get-Away	Day	Night
(A) Foot or Car	2 minutes	5 minutes
(B) Saddle Horse	5 minutes	10 minutes
(C) Pack Horse	10 minutes	20 minutes

(5) Travel Standards

(A) Vehicular

Drive at speeds which permit full control of the motor vehicle at all times. Do not exceed State or City speed limits.

(B) Foot and Horse Travel

Travel continuously. At night travel as far as possible until when dangerous to travel even with lights; then re-start at daylight.

CHAPTER II

PREPAREDNESS

Your Physical Condition

You will do a better fire job if you are in top physical condition.

Eat adequate, wholesome meals regularly.
Keep regular sleeping hours.
Develop physical stamina through hard work.
Remember that alcohol and fire always combine as a dangerous mixture.

Your Tools And Equipment

a. Fire hand tools -- maintained to standard, easy to get, in proper place, and ready to go.

b. Emergency rations, flashlight, canteen, clothing, and first-aid gear packed and properly stored, ready for immediate use.

c. Transportation -- serviced and ready to roll.

(1) Auto or pickup -- refueled, checked, and parked at ready after each trip.

(2) Tanker equipment -- in top condition, clean, inspected daily, complete with all accessories, at ready for immediate call.

(3) Pack and saddle stock -- watered, fed, checked; at ready after each trip.

d. Special fire tools -- back firing equipment, portable pumps, and portable radios, in top condition, complete, properly marked, at ready for immediate dispatch to fire.

Your Personal Fire Gear

As a fireman you will need personal gear and special clothing to help you do your fire job. Keep your fire bag ready at all times and include:

A change of trousers, shirt, underwear.
Several changes of clean work sox.
Heavy non-skid high top shoes or boots in good repair.
A warm, rugged jacket.
A well fitted hard hat.
Good work gloves.
Toilet articles including towel, soap, shaving kit, tobacco.
Sleeping bag.
Fireman's carrying case, complete. (This item seldom taken to off-forest fires.)
Also carry at all times a watch, pocket knife, safety matches, and Forest Service keys.

HOUSEKEEPING

The term is used to include your personal appearance and the maintenance of your station.

To the people you meet and associate with, you are the Forest Service. The public's impression of both you and the Service will be influenced largely by your personal appearance and the appearance of your station. Daily habits of orderliness will help you to do a systematic, effective job of everything you undertake, including fire suppression.

Personal Appearance

Shave daily unless on a fire, wash regularly and wear clean clothing. On ordinary work, which involves meeting people, green or suntan pants and shirt are the standard fireman uniform. Jeans or similar pants are suitable for fire-fighting or other rough work. Full-length shirt sleeves are necessary.

Your Forest Service badge will be worn only on the shirt. Pin it on the left pocket flap or immediately above.

Station Maintenance

Following are some of the more important standards of station maintenance:

Grounds And Yard...

Lawn, shrubbery, and yard well-kept and neat.
Trash and rubbish removed or burned when safe.
Petroleum products and inflammables properly stored and posted.
Fences and gates well maintained.
Garbage containers or pits currently cleaned, disinfected, and fly-proofed.

Buildings...

Buildings neat in appearance -- painted before weather damage occurs. Foundations free of damage by decay, insects.
Windows and doors -- neat appearance, currently cleaned and repaired.
Porches, railings, steps -- sound and in good safe repair. Loose boards, nails, and rails replaced.
Interior of building orderly and clean -- table clear of food and dishes.
Wood stored away from stove.
All stoves and appliances shecked and safe.

Improvements...

Water intake, storage, and distribution system clean and in good working condition -- system adequately protected from impurities, -- protected from weather and rodents.
Sanitation system -- toilet clean, deodorized, and disinfected as needed; pit, tank, and leaching field well-maintained in safe working order; no exposed sewage, pit fly-proof.
Out-buildings and other improvements -- maintained in neat, serviceable condition, free of safety hazards and fire hazards.

The public has an important investment in you and your station. Your job pays in the same proportion that you serve the public. While you occupy this station, do everything you can to maintain it in a neat safe, working condition.

STANDARD MAINTENANCE OF FIRE TOOLS

Effective fire control work is possible only with tools that are in good condition. The finest axe is worth very little in poor condition, and is downright dangerous if dull or loose on the handle. You are personally responsible for keeping equipment assigned to you in the best possible condition.

Check all tools before the beginning of the fire season each year to see that they are in proper condition and that the handles are tight. Recondition all tools immediately after use so that they are ready for the next fire.

Care Of Tool Handles

Handles should be kept smooth with fine sandpaper. They should be protected from exposure to weather if possible.

Rehandling Of Fire Tools -- Axes, Sledges, Pulaski, Brush Hooks

1. Remove broken handle by sawing handle off as close to head as possible and drive on through in direction it was inserted.

2. Inspect the eye of the axe or other tool for cracks. Remove burr edges at the ends of the eye.

3. Fit the handle to the eye as tightly as possible. Drive the handle through the eye, leaving 1/2 inch shoulder and a smooth wood surface in the eye. The shoulder should not bulge.

4. A correctly fitted handle is at right angles to the axis of the blade.

5. After the handle is fitted, remove it and saw a wedging slit down the center, parallel to the flat sides of the axe. Saw to a depth that will be 2/3 the way through the eye when the handle is driven home.

6. Drive the handle firmly into position.

7. Drive a sound, dry, softwood wedge into slit as far as possible, but avoid splitting the handle.

8. Saw off excess length of handle and wedge with a hack-saw, dress off with coarse file, and paint end of handle.

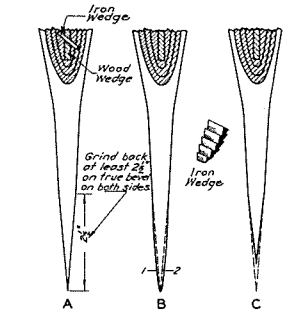
9. Drive two iron wedges at a 45 degree angle to the wooden wedge being careful not to spread the eye. (Use only one wedge on sledges.)

Sharpening Fire Tools

When sharpening axes and similar cutting tools, always be careful not to overheat the cutting surface. Grind to within 1/4 inch of cutting edge. Finish off with file or whetstone. Sketches that follow illustrate tools that have been properly sharpened and maintained.

Axes...

Grind both sides to an even taper at least 2 1/2 inches back from the cutting edge.



A – Well ground axe indicating proper taper to cutting edge.
B – Improperly ground axe. Shoulders at (1) and (2) should be reduced so axe appears as indicated by dotted lines.
C – Frequent grinding will shorten blade but proper cutting edge should be preserved as indicated.

Fig. 55

Principles Observed in Sharpening Axes

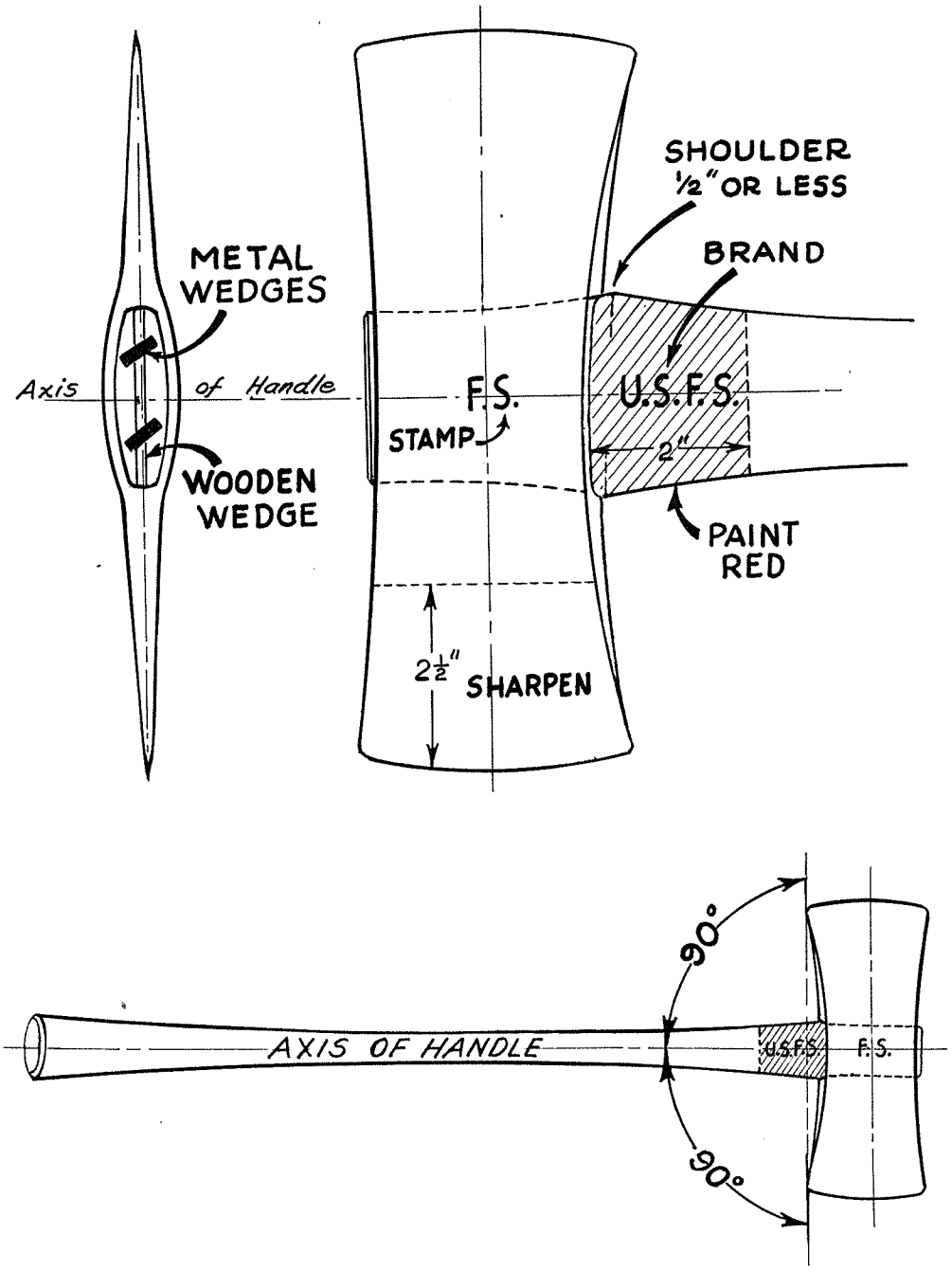


Fig. 56

Double Bitted Axes - Standard Maintenance

Pulaski...

Axe bit to be ground sharp in an even taper back from the cutting edge at least 2 1/2 inches. Hoe side ground to a good cutting edge, the bevel to be approximately 3/8 inch deep on the inside of the blade; that is, on the side facing the handle.

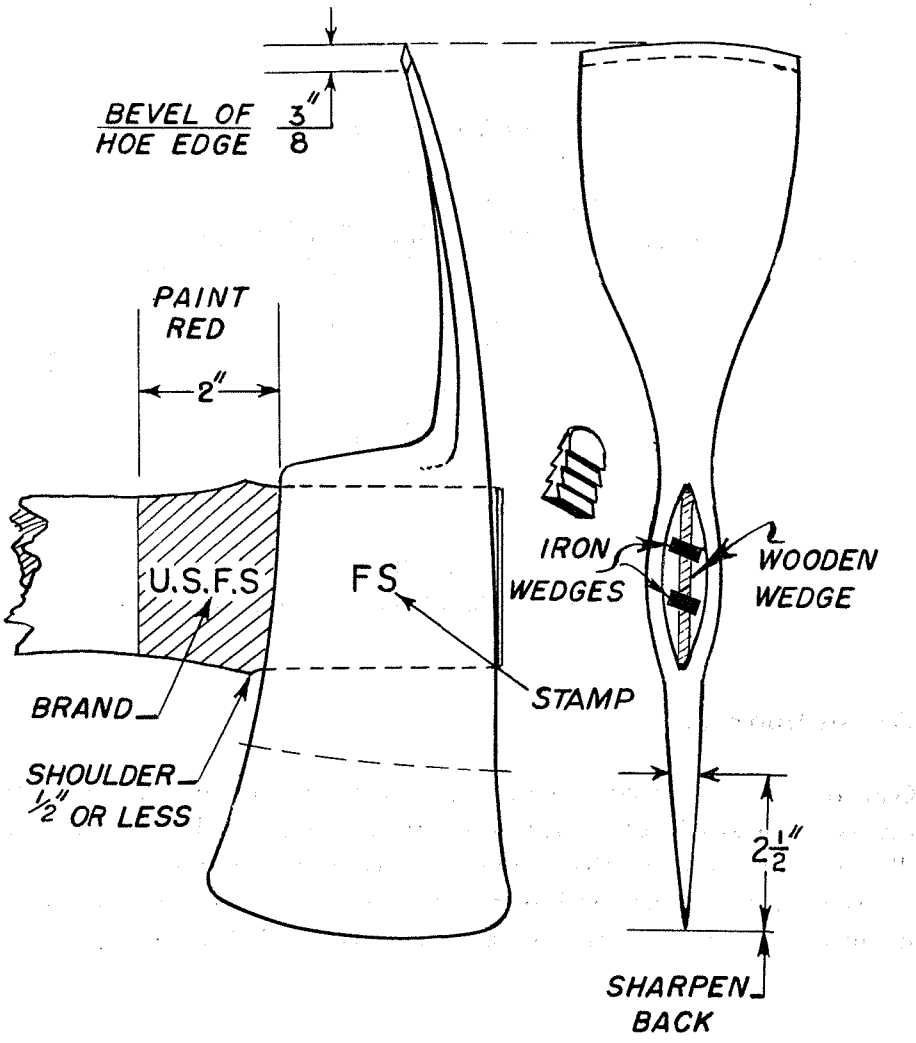


Fig. 57

Pulaski Tool - Standard Maintenance

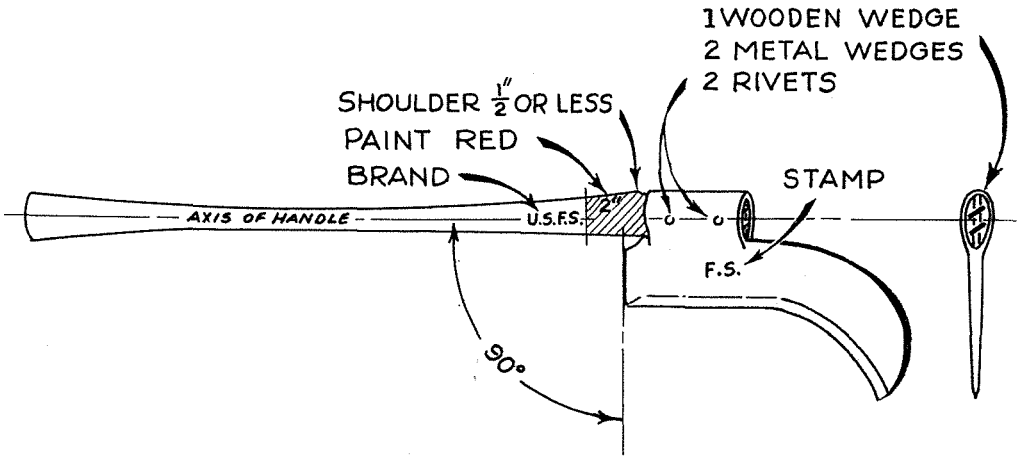


Fig. 58
Brush Hook - Standard Maintenance

Brush Hook...

Grind both sides of the long portion of the cutting edge in an even bevel back from the cutting edge at least 1 inch. Take care to keep the circular pattern at throat. Carefully grind the throat back 1 inch on an even bevel. Grind hook or point on a bevel approximately 3/4 inch deep.

Shovel...

Each edge of the shovel is sharpened from the point to approximately 3 1/2 inches from the top of the blade, the bevel being on the top face of the blade.

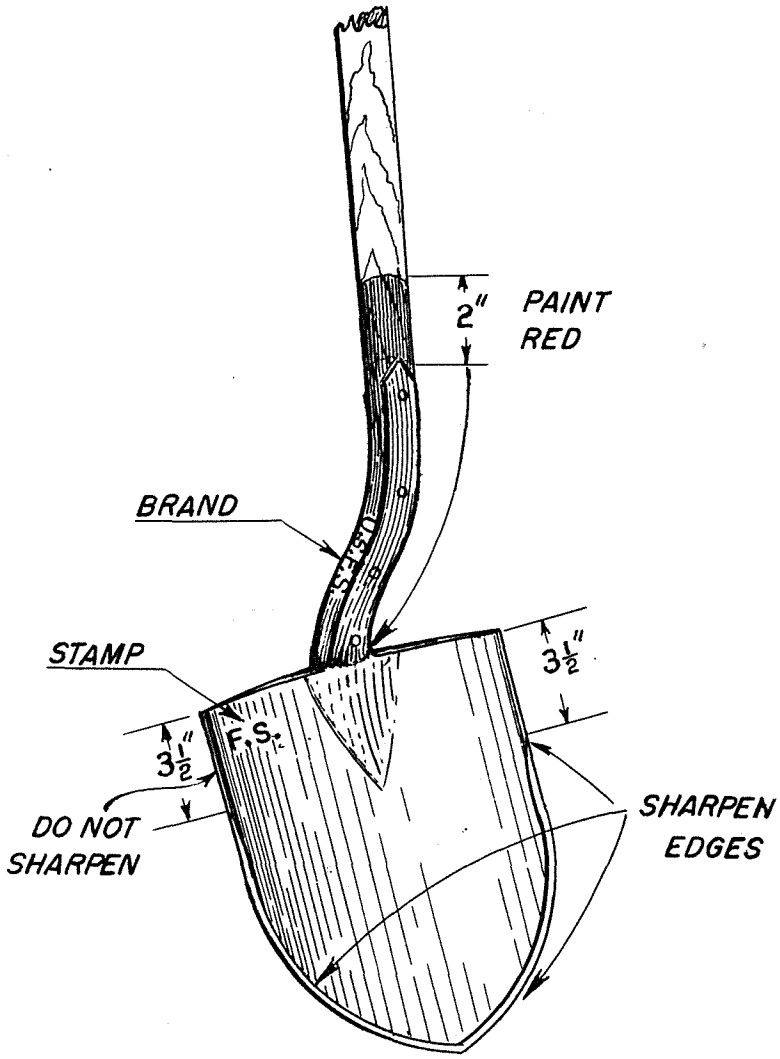


Fig. 59
Shovel - Standard Maintenance

McLeod Tool...

Grind the hoe so there is a good cutting edge on the inside face; bevel to slope outward at an angle of approximately 45 degrees. Bevel to be on outside of blade away from handle.

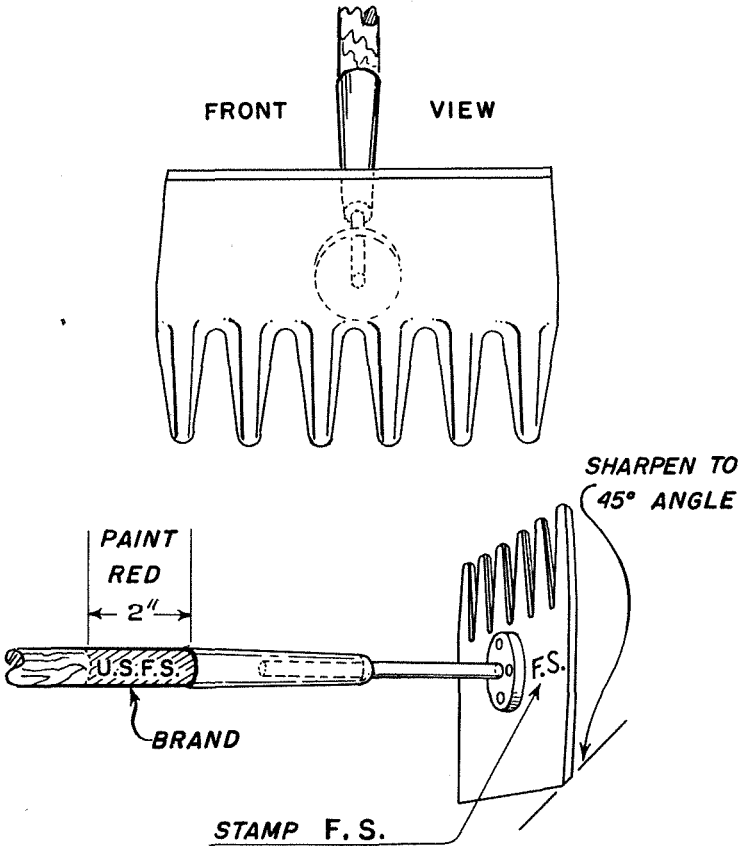


Fig. 60

McLeod Tool - Standard Maintenance

Sledges...

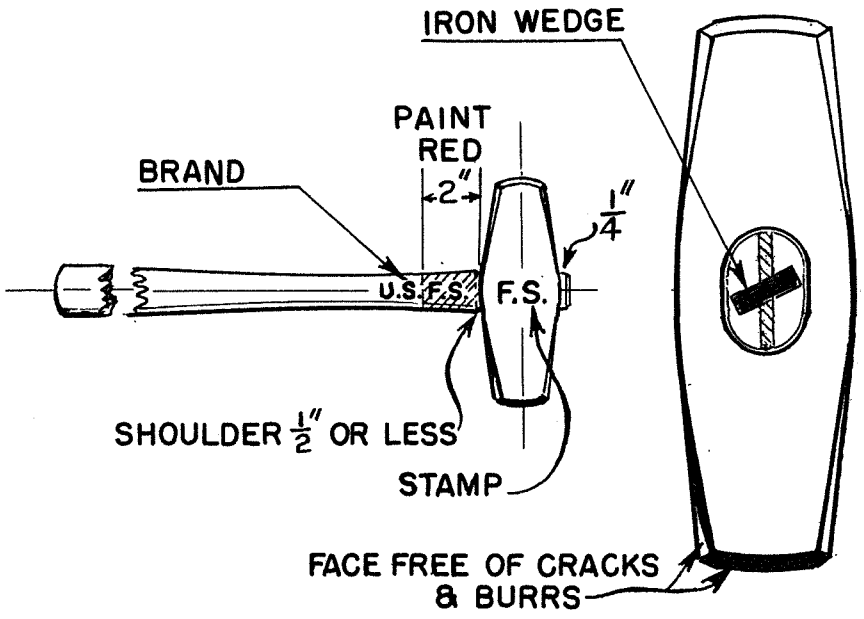


Fig. 61
Sledges - Standard Maintenance

Marking Fire Tools And Equipment

To prevent theft and as a means of ready identification, all fire tools and equipment must be marked.

As a permanent mark of identification, all metal parts of fire tools will be stamped "F.S." and the handles branded "U.S.F.S." Put a band of red paint on the wooden part of the handle, but don't paint more than 2 inches above the point where the wood joins the metal. Use red paint only on fire equipment. Water bags, buckets, canteens, beds, blankets, sleeping bags, tents, and all other similar equipment are to be stenciled "U.S.F.S." in letters at least one inch high, or marked with the regulation shield, preferably the latter.

The F. S. die will be stamped at a specified place on the blade or head of each tool. The following system is standard:

Axe, Double Bit - Stamp on either side, middle of eye. (See Fig. 56.)
Pole Axe - Right hand side, middle of eye.
Pulaski - Right hand side, middle of eye, assuming use as an axe. (See Fig. 57.)
Brush Hook - Right hand side of blade. (See Fig. 58.)
Shovel - Right hand corner of upper side of blade, when in position for use. (See Fig. 59.)
McCleod Tool - Right hand side of upper side of blade when in position assuming use as a hoe. (See Fig. 60.)
Sledge - Either side, middle of eye. (See Fig. 61.)
One-man Saw - Right hand side, close to handle, near top.
Cross Cut or Felling, Two-man Saw - Either side at end.

In stamping fire tools not listed above, place the brand on the upper right-hand side of the tool when it is in its proper position for use.

The U.S.F.S. brand will be placed on the handle of all fire tools, as follows, when in position for use:

Axe, Double Bit - Either side of handle, against head. (See Fig. 56.)
Pole Axe - Right side of handle, against head.
Pulaski - Right side of handle, against head, assuming use as axe. (See Fig. 57.)
Brush Hook - Right side of handle, against head. (See Fig. 58.)
Shovel - Right side of handle, against shank. (See Fig. 59.)
McLeod Tool - Right side of handle against shank, assuming use as hoe. (See Fig. 60.)
Sledge - Either side of handle, against head.
One-man Saw - Right side of handle.
Saw Handle, Cross Cut, Two-man Saw - Right side of handle, opposite center bolt.

Rust Prevention

Axes, Shovel, Pulaski, And Like Tools...

Oronite priming solution or comparable material will be applied to metal parts of fire tools, such as axes and shovels to prevent rust when tools are not being used. Apply the solution with a small brush, being careful to apply only a light coating.

Repairing Other Fire Tools And Equipment

Gasoline Lanterns...

The most common troubles and remedies are:

Dirty gasoline - Remove dirt from container. Refill with clean white gasoline.
Plugged generator tip - Replace or clean with fine wire.
Broken mantle - Replace.
Pump will not work - Drop of oil or replace gasket.
Leaky filler cap - Replace gasket.
Broken check valve - Replace valve.
Bowl broken at seams - Discard. Do not try to solder.
Leady generator valve - Replace.
Extra mantles, generators, and tips should be kept on hand.

Precautions To Observe In Use Of Gasoline Lantern...

Fill bowl only 3/4 full of white gas to allow space for pumping air.
Heat the generator with a match and turn on gas only after the lantern has started to generate.
Discard any lantern with leaky bowl or joints.
Repair any lanterns with leaky valves.
Fill lantern outdoors, preferably using small filter funnel to avoid spilling gasoline.
Never fill around open flame. Use flashlight for light when filling at night.
After filling wipe the lantern carefully before lighting.
Never replace the filler plug by a cork or home-made plug.
Leave top of lantern and shade on when in use.
Place or hang sufficiently far from walls or ceiling to prevent starting fires.
Use only white gasoline.

Electric Headlamp...

Following are the main points to check when electric headlamp does not work:

If, after progressively trying a new bulb, fresh batteries, checking all connections, and increasing the tension of spring in cap, the headlamp does not work, two things remain to be checked -- the cord for breaks, and the switch. The cord can be checked by using a telephone battery. Test each wire in the cord by placing one end of the wire on one pole of the battery and touching the other pole with the other end of the wire. If sparks result, wire is not broken.

If the headlamp does not work after these tests, the switch is defective. Repair by replacing case. Destroy old case.

To prevent battery drain during storage, place a piece of cardboard or heavy paper on top of the upper batteries before closing the case.

Backpack Pump...

In reconditioning a backpack pump, the following points should be checked:

If container leaks, and this is due to minute holes or seams slightly sprung, remedy by soldering. If tanks are badly rusted, destroy.

Hose connections should be tightened; if the hose leaks, replace with new hose.

The plunger washer is usually at fault if the pump will not work. Replace with a new washer.

Sometimes the pump works too hard for any of three causes:

1. The plunger barrel may be gummed up. The trouble can be remedied by cleaning with solvent.
2. The packing gland nut may be screwed up too tight. It can be loosened, but if this causes the pump to leak, repack pump.
3. Barrel or plunger may be badly bent. Pump must be replaced. Destroy old pump.

A plugged nozzle is generally caused by some foreign substance getting into the jet. Remove the nozzle and clean the jet with a small wire. This trouble can be avoided by using clean water.

A nozzle leaking around the joint may be remedied by replacing the washer at the joint.

Canteens...

If kept filled, change water frequently. To freshen, rinse the canteen with a tablespoon of baking soda mixed with a quart of water. If cap leaks, replace gasket or cap. Check and replace straps, if necessary. If canteen has been used for gasoline, oil or liquid other than water -- destroy.

Care Of Fire Hose

Storage...

Fire hose of all types should be kept rolled or folded in cool, dry, ventilated, rat-proof room.
Always clean and dry hose thoroughly before storing.
Do not store with paints, oils, or near sharp cutting edges.
All hose should be rerolled or refolded at least once a year, reversing roll or fold.

Cleaning Hose...

Clean hose after each fire.
Wash cotton jacket or linen hose with plenty of clean water, using broom or semi-stiff brush. Exceptionally dirty hose may be scrubbed with mild soap or detergents providing it is thoroughly rinsed with clean water after scrubbing.
Rubber-covered hose should be wiped clean with damp rag.
Drain hose after washing and dry thoroughly. Avoid exposure to hot sun for long periods.

Testing Hose...

Test all hose before start of fire season.
All hose should be tested to withstand 250 pounds per square inch pressure.
Test with tanker or static type hose-testing pump. Hold pressure 30 seconds.
Test pressures should at least equal maximum discharge pressure of available tanker, if not capable of reaching 250 pounds.

Rolling Hose...

Neatly rolled hose which can be quickly and easily put into service adds speed to hose lays. Roll it this way:

Lay one hose length on the ground. Carry male end back over the hose to a point 4 feet from the swivel (female) end. Roll from the loop end -- not too tightly. Tie with string or twine, using a bow knot which is easily loosened, or bind with large rubber bands.

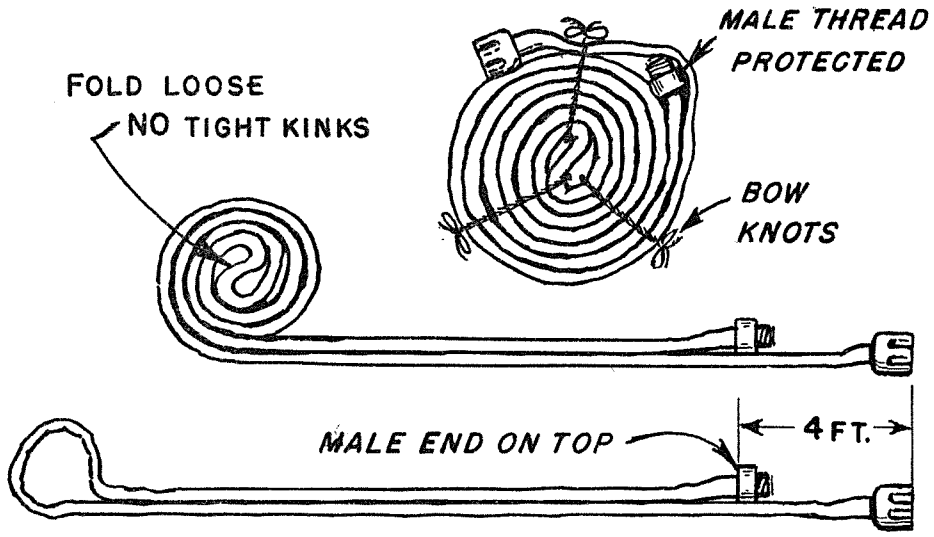


Fig. 62

Proper Method of Rolling Hose

FIREMAN'S WEEKLY INSPECTION

Once a week you will take complete stock of your gear to make sure you have everything up to standard and ready to go. You will use the weekly inspection form to make sure that everything is checked.

If an item is O.K., you check it off. If it is not, fix it if you can and then check it off. If it is something you can't fix, report it to the Ranger.

Once a month, the Ranger or his assistant will make the same inspection with you. The Ranger will tell you what is right and what is wrong and teach you how to correct the things that are wrong. You should ask questions about things you do not understand.

The weekly inspection will include your fire tool cache. Be sure it is complete and that tools are in good condition. Use the tool cache card "Invoice of Tools in Cache at_____" as a guide and record. A sample of the card follows the Weekly Inspection Form in this handbook.

Form 80-R5
Revised April 1954
Page 1 of 4 pages

FIREMAN'S WEEKLY INSPECTION FORM

Location _____ Forest _____

Name of Fireman _____ Month _____ Year _____

To be used by all Firemen and Lookouts. Form provides for four weekly inspections by Fireman and Lookouts, and one monthly inspection by Ranger or Assistant. Use ✓ if O. K. Use 0 if not O.K.

	Fireman's Inspection				Ranger's Inspection
Date					
A. PERSONAL Initial					
I. APPEARANCE: Clean, neat, and shaven					
III. PERSONAL EQUIPMENT REQUIRED:					
a. Watch - checked daily					
b. Proper footgear, work clothes and hard hat for firefighting					
c. Uniform, standard and presentable					
d. Subsistence supplies. Sufficient for two weeks (if required)					
e. Fireman's carrying case. Contents checked and complete in accordance with Forest and District standards					
f. Diary - properly kept up to date					
g. Job list followed					
B. STATION BUILDING AND GROUNDS (Refer to Safety Code Part 3)					
I. APPEARANCE AND SANITATION:					
a. Interior neat, clean, orderly					
b. Windows clean					
c. Dishes washed and put away					
d. Stove clean - polished if required					

Fig. 63

	Fireman's Inspection				Ranger's Inspection
Date					
Initial					
e. Garbage can clean					
f. Bed made neatly					
g. Grounds clean and neat					
h. Woodpile stacked					
i. Storeroom stock neatly shelved and racked					
j. Garbage pit adequate; cover tight and disinfected					
k. Toilet and pit adequate					
Flyproofed and disinfected					
II. FIRE PREVENTION (Refer to Safety Code Part 3)					
a. Stovepipe in good condition					
Terra cotta flues not cracked					
Metal pipe joints secured by metal screws					
b. Spark arresters in good condition					
c. Metal shield or stove mat under wood stove					
Metal or asbestos between stove and walls					
d. Woodbox away from stove					
e. No fires started with kerosene or gasoline					
f. Fire extinguisher filled and tested					
Handy and in designated place					
g. Fire ladder available and in place					
h. Hazards cleared around all buildings					
i. Ashes emptied in designated safe place					
j. Gasoline and oil stored in designated safe place					
Gasoline lanterns filled outdoors					

	Fireman's Inspection				Ranger's Inspection
Date					
Initial					
k. Electrical wiring, including extensions in good condition					
l. Bottled gas properly handled and stored (Section 625, Safety Code)					
III. IMPROVEMENTS AND FACILITIES (Refer to Safety Code Part 3)					
a. Water and fuel supply adequate for Fireman's family during his absence					
b. Station signs and posters replaced when necessary					
c. Flag in good condition. Displayed properly. Rope satisfactory					
C. TRANSPORTATION (Refer to Safety Code Part 8)					
I. PERSONALLY OWNED AUTOMOBILE OR TRUCK IF USED ON FIRE JOB (Safety Code Section 83- Motor Vehicles)					
a. Oil at proper level in crank case					
b. Radiator full of water					
c. Tires in good condition					
d. Tires inflated					
e. Spare tire - in good condition and inflated					
f. Tools to change tires					
g. Gasoline tank full					
h. Brakes effective					
i. Lights will work					
j. Battery charged - full of water					
k. Regularly lubricated					
l. General condition good					
m. Required firefighting tools, including filled canteen and emergency rations in car					

	Fireman's Inspection				Ranger's Inspection
Date					
Initial					
n. Located for quick getaway					
II. INSPECTIONS OF GOVERNMENT VEHICLES MADE IN ACCORDANCE WITH PRESCRIBED FORMS					
III. HORSES OR MULES (Refer to Safety Code Part 8, Section 81)					
a. Good condition					
b. Shod - shoes tight					
c. Kept up during specified hours					
d. Equipment clean and in good repair. Saddle blankets clean					
e. Fire tools, grain, filled canteens, and emergency rations with equipment					
f. Forage supply adequate					
g. Fences and corrals stock tight					
h. Manure disposed of currently					
D. EQUIPMENT					
I. SPECIALIZED EQUIPMENT INSPECTED IN ACCORDANCE WITH FORMS AND CHECK LIST PROVIDED					
a. Daily Tanker Inspection Form 127-R5					
b. Weekly Tanker Inspection Form 128-R5					
Others, list					
c. _____					
d. _____					
e. _____					
II. FIRE TOOL CACHE INSPECTED USING FORM 21-R-5					
III. IMPROVEMENT TOOLS MAINTAINED IN SAFE WORKING CONDITION					
a. Hatchet or short handled, single bit axe used for splitting kindling					
E. SAFETY					
I. ALL HAZARDS WHICH MIGHT CAUSE INJURY OR ACCIDENTS AT YOUR STATION CORRECTED OR REPORTED					

INVOICE OF TOOLS IN CACHE AT_____

Article	No.	Article	No.	Article	No.	Article	No.
Axes, D. B.		Headlamps, electric w/batteries		Pulaskis		Torches, backfiring	
Axes, S. B.		Kits, first aid pocket		Radio, portable		Torches, fusee	
Backpack Pump		Kits, snakebite		Saws, falling w/guard and handle		Wedges, falling (hand saw)	
Bags, Sleeping		Knapsacks		Saw, power		Wedges, falling (power saw)	
Blankets		Lanterns, gasoline, w/gas and mantles		Shears, pruning			
Brush Hooks		McLeod Tools		Shovels			
Canteens 1 gallon		Mess Kits ____Man		Sledges			
Files w/handle and guard		Milk cans		Telephone, portable			
Hats, hard		Packboards		Telephone wire emerg. (Miles)			

RECORD OF USE

Fig. 64

GUIDE FOR CLOSING FIREMAN STATION

Winter weather in the mountains is usually severe. It can damage improvements and equipment if precautions are not taken when you close your station. Furthermore, it is often important that the station be readied for use as quickly as possible in the spring. When closing the station for winter, see that all improvements, tools, and gear are cleaned and well-protected against wind, moisture, snow, and rodents. The following check list will bring to mind many, but not all, of the items needing treatment.

Water System

Drain thoroughly -- shut off water supply, open all faucets, drain storage tank; drain all lines at low points; drain hot water tank and hot water coils in stove; leave low points open. Leave note showing what should be done to turn water on. Clean and dry milk cans or water containers; apply light coating of mineral oil and store upside down with ventilation.

Sanitation System

Drain and mop out toilet tanks and bowls -- salt may be used in certain cases to prevent freezing.
Drain sink goosenecks.
Empty all garbage and waste; wash and store garbage cans.

Stoves

Remove ashes, clean thoroughly. Apply coating of mineral oil to all parts that may rust, including pipe.
Shut valve and properly store all bottle gas or oil.
Securely fasten a can or top over stove pipe.
Leave enough dry wood or fuel for emergency use.

Utensils And Food

Apply light coating of mineral oil to utensils that will rust; store upside down to prevent collecting moisture.
Matches must be stored in rodent-proof metal or glass container.
Remove all food that will freeze and break or spoil, and all food that is exposed to rodents.
Leave some C-Rations in rodent-proof containers for emergency use.

Bedding

Store bedding to keep dry and free from rodents or suspend by wire from ceiling.

Buildings

Leave building clean inside and out. Dispose of rubbish and waste.
Securely lock or fasten all windows and doors, unless otherwise instructed.
Lower or shut, and bolt or lock all storm shutters to withstand severe storms.

Communication Equipment

Transfer portable radios to headquarters.
Disconnect telephone batteries and battery cable of stationary radio.
Protect all dry batteries from moisture. (Cover or move if necessary.)
Get local instruction on what to do with stationary radio, aerial, and wet batteries. In any event, the radio must be protected from moisture and the aerial from snow and wind breakage.
Throw switch or disconnect telephone from main line.
Leave note on telephone, instructing how to connect and use.

Miscellaneous Tools And Equipment

All tools and equipment should be stored in a dry place.
Headlamps -- remove batteries to prevent corrosion.
Fire extinguishers (except pyrene or dry powder) -- drain, wash out, store upside-down and ventilate.
Anemometer -- remove from support, oil with anemometer oil, store inside.
Weather instruments -- clean and store inside.
Hand tools -- clean and oil as needed, store in dry place.

Inventory

Make a complete inventory of all tools, property, and equipment left at the station.
Make a separate inventory of property returned to headquarters. Leave copies of inventories at station and at headquarters with notations of shortages or replacement needs.

Tent Camps Or Stations

All equipment except tent frames, platforms and other camp developments, will normally be returned to headquarters.
Tents and flies will be dried, neatly folded, and tagged showing size, condition, repairs needed, and station location, before storage.
Tent frames may require bracing to withstand snow load.

REVIEW QUESTIONS - PREPAREDNESS STANDARDS

1. Why is preparedness important?

2. What is the standard fireman uniform for ordinary work which involves meeting people?

3. Where is the badge worn?

4. Why should the fireman station be kept clean and neat?

5. How often does the fireman make a systematic inspection of his station?

6. Why does he use the Weekly Inspection form for his job?

7. When closing a fireman's station for the winter, why, in your opinion, does the fireman:

   a. Drain all water lines?
   b. Oil the stove, stovepipe?
   c. Suspend blankets from ceiling?
   d. Make a property inventory?

8. What is your responsibility in regard to equipment assigned by your superior? When should fire tools be reconditioned?

9. What defects should you look for when inspecting an (1) axe, (2) Pulaski, (3) shovel, (4) canteen, (5) back-pack pump, (6) McLeod?

10. How often should you inspect your assigned fire tool cache? How and where do you record such an inspection?

11. How wide a band of red paint should be applied to fire tool handles?

12. How do you safeguard headlamps against battery drain?

13. How far from the cutting edge of an axe bit should the sharpening bevel extend?

14. At what pressure should you test cotton jacket rubber lined fire hose?

THE PUBLIC LAND SURVEY

To locate a fire with a map, some knowledge of the system of the Public Land Survey is necessary. The land is subdivided into rectangular tracts, and a knowledge of this system enables you to find or refer to blocks of land in the mountains as simply as you find or refer to city blocks by the street names and numbers.

TOWNSHIP SUBDIVISIONS

The land is divided by cardinal lines (lines which run due north, south, east, or west) into townships which are intended to be six miles square.

The townships are divided by cardinal lines into 36 sections, each normally one mile square.

The acre is the standard unit of area. One acre equals 10 square chains or 43,560 square feet and there are 640 acres in a section.

Example: The section is one mile square; that is, 80 chains by 80 chains, or 6400 square chains. Point off one place to divide by 10, and the result is 640 acres.

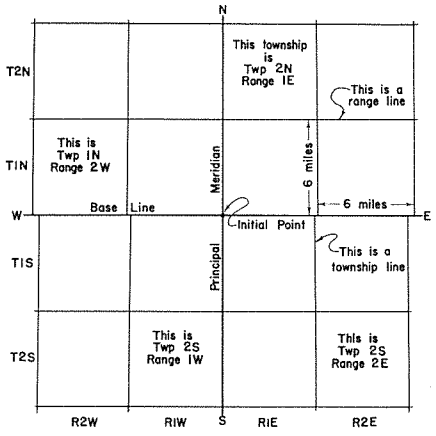


Fig. 65
System of Referencing Townships

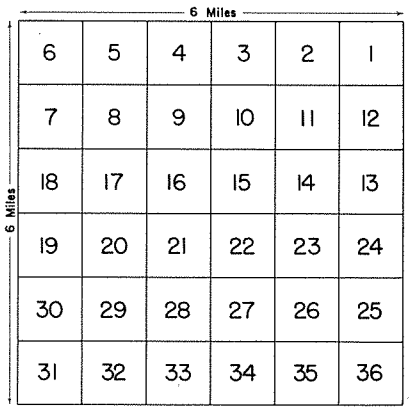


Fig. 66
Numbering Sections Within Townships

SECTION SUBDIVISIONS

The section is divided into quarter sections; which are not shown on field maps, as follows:

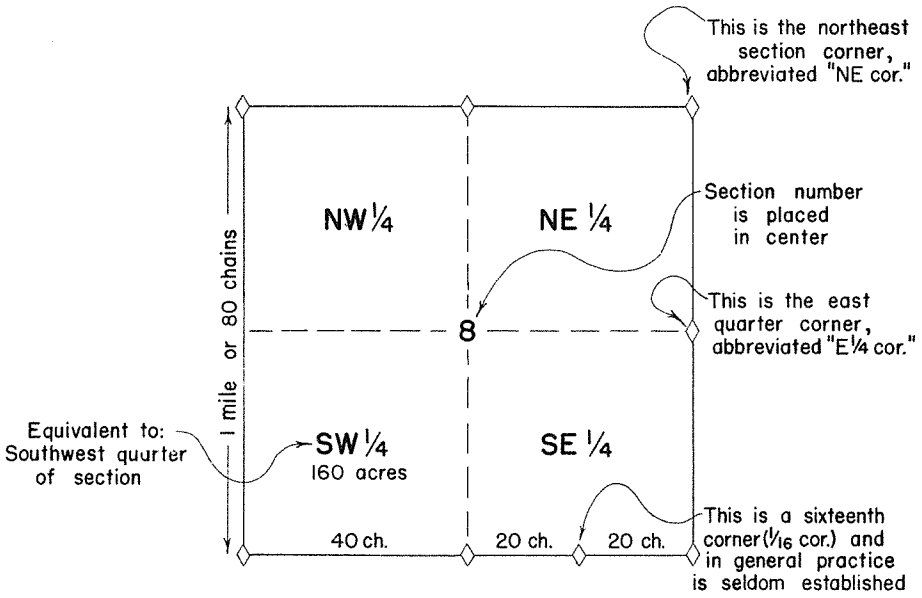

This is the northeast section corner, abbreviated "NE cor."
NW¼
NE ¼
Section number is placed in center
This is the east quarter corner, abbreviated "E¼ cor."
8
1 mile or 80 chains
Equivalent to: Southwest quarter of section
SW ¼
160 acres
SE ¼
This is a sixteenth corner(1/16 cor.) and in general practice is seldom established
40 ch.
20 ch.
20 ch.

Fig. 67 Subdivision of Section into Quarter Sections

The quarter section may be subdivided further as shown below:

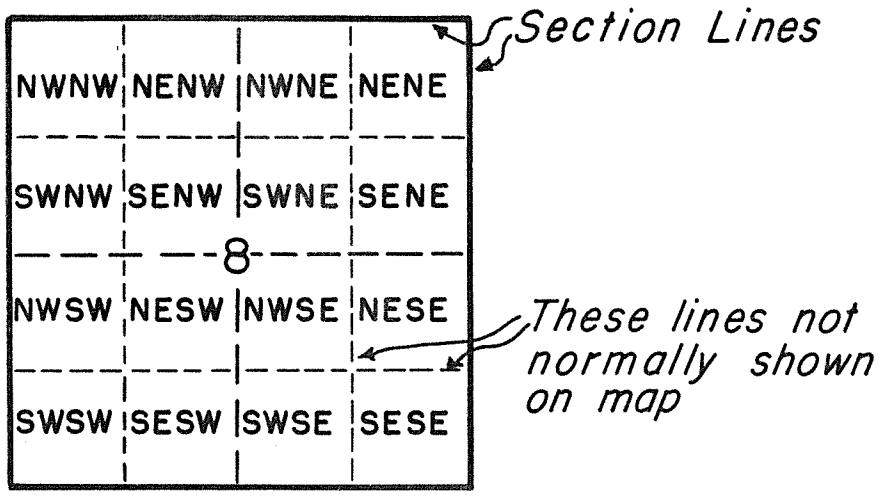


Fig. 68 Subdivision of Quarter Sections

Location Posters

Location posters, sometimes called Section Corner Markers, Section Line Markers or Cruiser Tags (See Figs. 70 and 71.) are used by the Forest Service and by some lumber companies and private land owners, to indicate the location of Section Corners and points where roads or trails cross section lines. These posters, about 4 1/2 inches or 5 inches in size, usually are of metal, with lines on a yellow background. In recent years unpainted aluminum tags with the lines and lettering stamped on them have been used also. The township, range, and section are marked on the poster. A tack driven at the appropriate place on the poster shows where the poster is located according to the Public Land Survey. Usually the distance to a section corner is marked on the poster. Referring to the map in Fig. 69 Points B and C would probably be identified in the field by location posters similar to Fig. 70 and Point A by a location poster similar to Fig. 71.

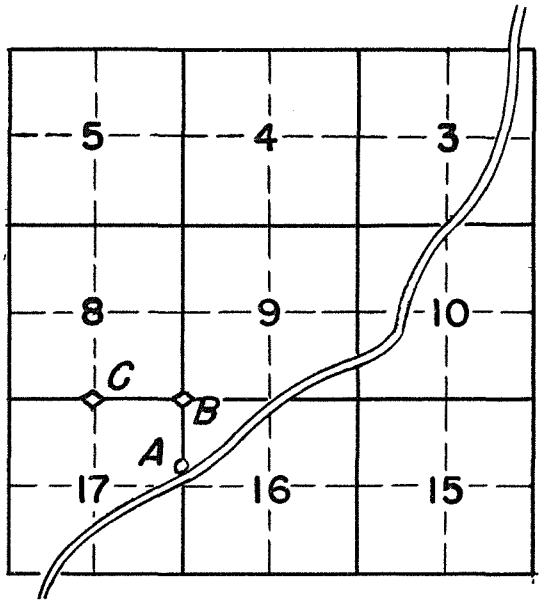


Fig. 69

Portion of a map showing typical points where location posters are commonly placed.

A. Where roads cross section line
B. At Section Corners
C. At Quarter Section Corners

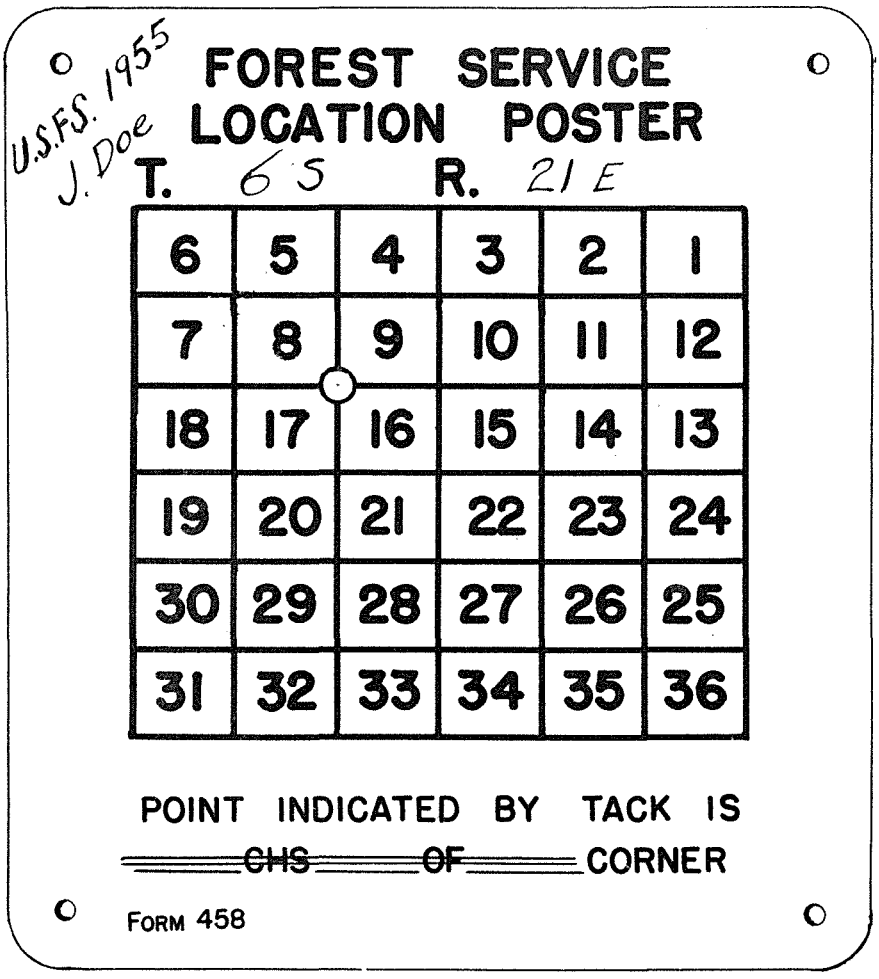

U.S.F.S. 1955
J. Doe
FOREST SERVICE
LOCATION POSTER
T. 6 S R. 21 E
6 5 4 3 2 1
7 8 9 10 11 12
18 17 16 15 14 13
19 20 21 22 23 24
30 29 28 27 26 25
31 32 33 34 35 36
POINT INDICATED BY TACK IS
CHS OF CORNER
FORM 458

Fig. 70

Location Poster for Indicating
Section Corners

This is an example of one type
of poster usually placed at
Section Corners.

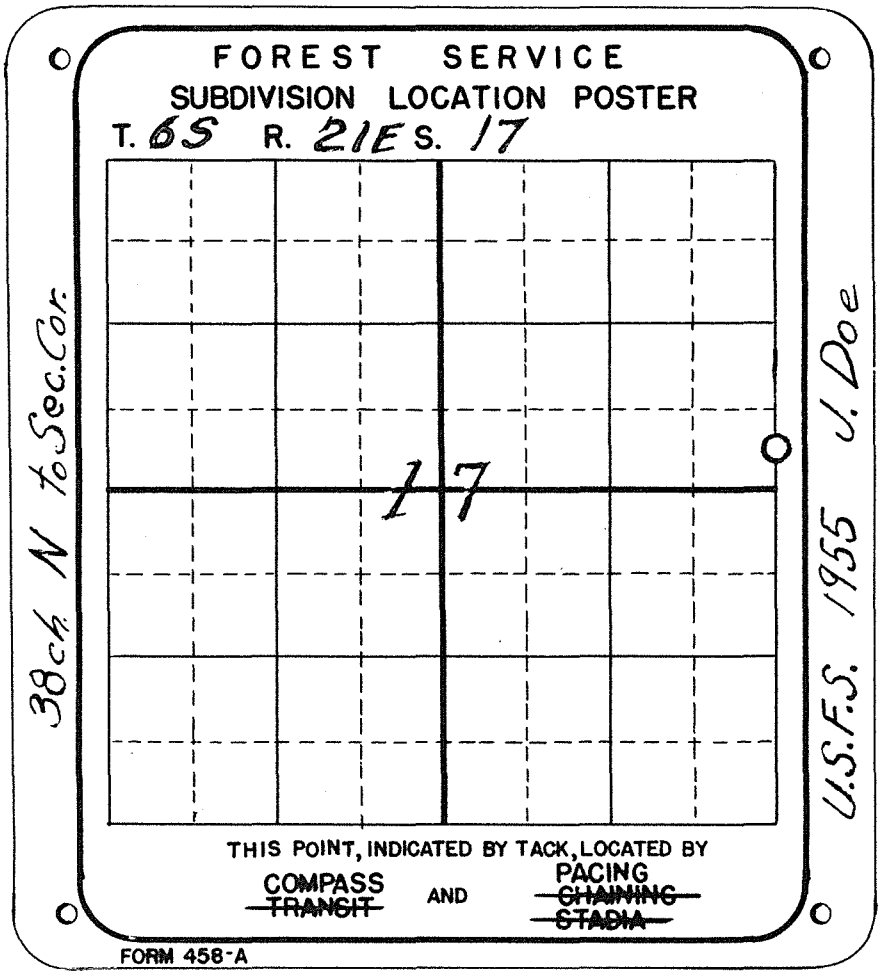


Fig. 71

Location Poster for Indicating
Section Lines

This is an example of a type of poster sometimes used at a road or trail crossing of a section line, or at a Quarter Section Corner.

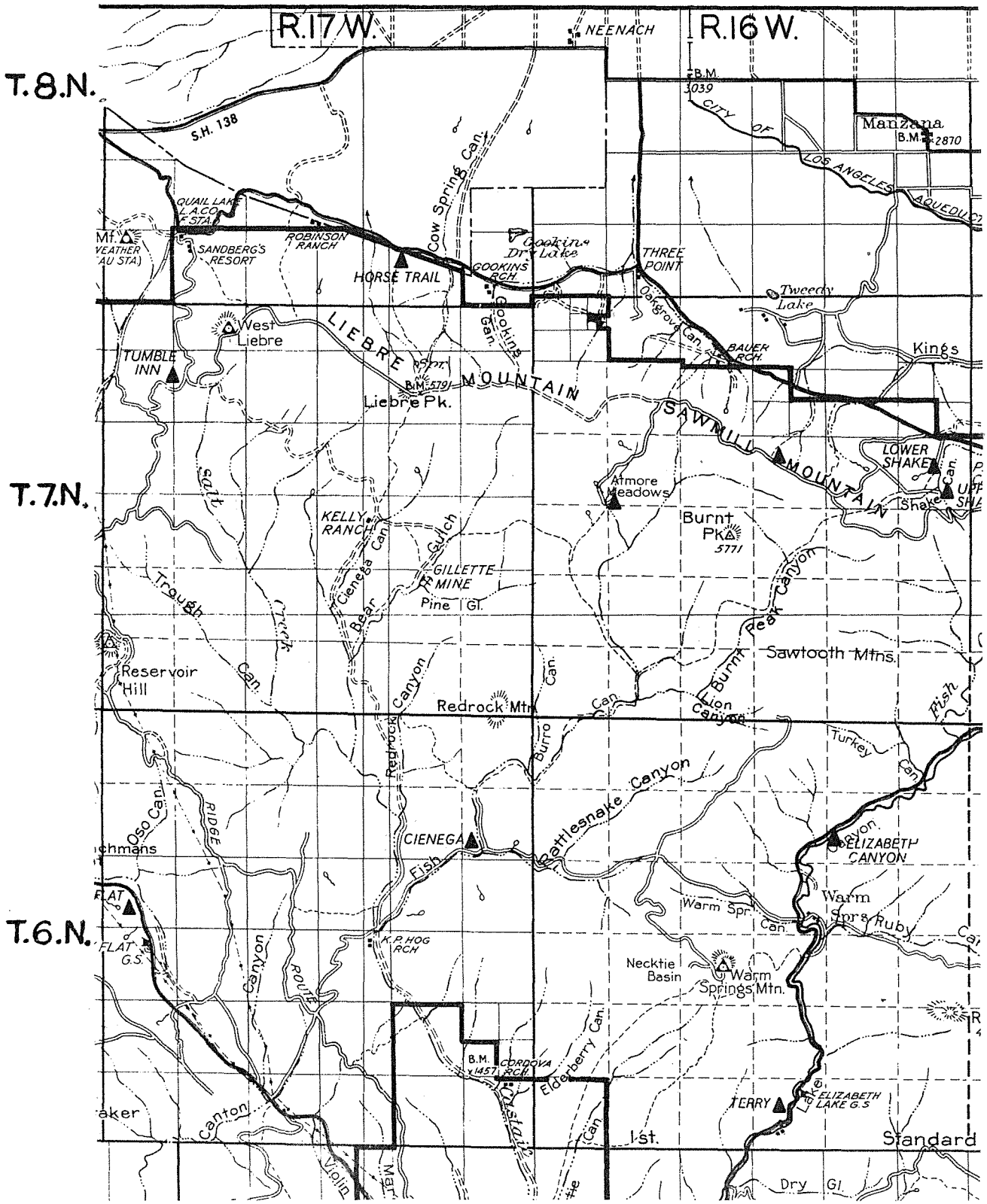

R.17W.
R.16W.
T.8.N.
T.7.N.
T.6.N.
NEENACH
S.H. 138
B.M. 3039
CITY OF LOS ANGELES AQUEDUCT
Manzana
B.M. 2870
QUAIL LAKE L.A.C.O. STA.
Mt. (WEATHER (AU STA.)
SANDBERG'S RESORT
ROBINSON RANCH
HORSE TRAIL
Cow Spring Can.
Cookins Dry Lake
COOKINS RCH.
THREE POINT
Campground Can.
Tweedy Lake
Kings
BAUER RCH.
West Liebre
TUMBLE INN
LIEBRE MOUNTAIN
B.M. 5791
Liebre Pk.
SAWMILL MOUNTAIN
LOWER SHAKE
Shake
Atmore Meadows
Burnt Pk. 5771
KELLY RANCH
Cienega Can.
GILLETTE MINE
Pine Gl.
Trough Can.
Bear Gulch
Peak Canyon
Sawtooth Mtns.
Reservoir Hill
Redrock Mtn.
Redrock Canyon
Burro Can.
Lion Canyon
Fish Can.
Turkey Can.
Rattlesnake Canyon
CIENEGA
Oso Can.
RIDGE
Fish
ELIZABETH CANYON
Warm Spr.
Warm Spr. Ruby
FLAT
FLAT G.S.
K.P. HOG RCH.
Necktie Basin
Warm Springs Mtn.
ROUTE
Canyon
B.M. 1457
CORDOVA RCH.
Elderberry Can.
TERRY
ELIZABETH LAKE G.S.
Canton
Violin
1st. Can.
1st.
Standard
Dry Gl.

Fig. 72

Problem 1: Locate A Specified Area On A Map From A Written Description

Condition...

Given the legal description: Southwest Quarter of Southwest Quarter of Section 12, Township 6 North, Range 17 West. (This is normally abbreviated as: SW1/4 SW1/4, Sec. 12, T. 6 N., R. 17 W.) Find this on the map, Fig. 72.

Action Required...

1. On the map margin find the symbol T. 6 N.
2. Follow across the map between the heavier horizontal lines until you are directly below a marginal symbol R. 17 W. This locates Township 6 North.
3. Locate Section 12 in this Township. (See Fig. 66 for system of numbering sections.)
4. Subdivide this section into quarter sections. Locate the Southwest 1/4 of Section 12.
5. Divide this quarter section into quarters. Locate the Southwest Quarter of the Southwest Quarter.
6. If you have solved this problem you will have located Cienega Campground.

Problem 2: Give The Legal Description Of An Area Marked On The Map

Condition...

Use map in Problem 1. In the Northeast portion of the map you will find Burnt Peak. Describe the location of this peak using legal subdivisions to nearest quarter section.

Action Required...

1. Trace horizontally to margin and get T. 7 N..
2. Trace vertically to margin and get R. 16 W.
3. Count sections. Start at Section 1 in the upper right hand corner of the township and left, then right horizontally -- count to Section 21.
4. Divide Section 21 into quarter sections.
5. Burnt Peak is located in the Northeast Quarter of Section 21. The legal description is: NE1/4 Sec. 12, T. 7 N. R. 16 W.

Problem 3: Orienting Map Without Use Of Compass

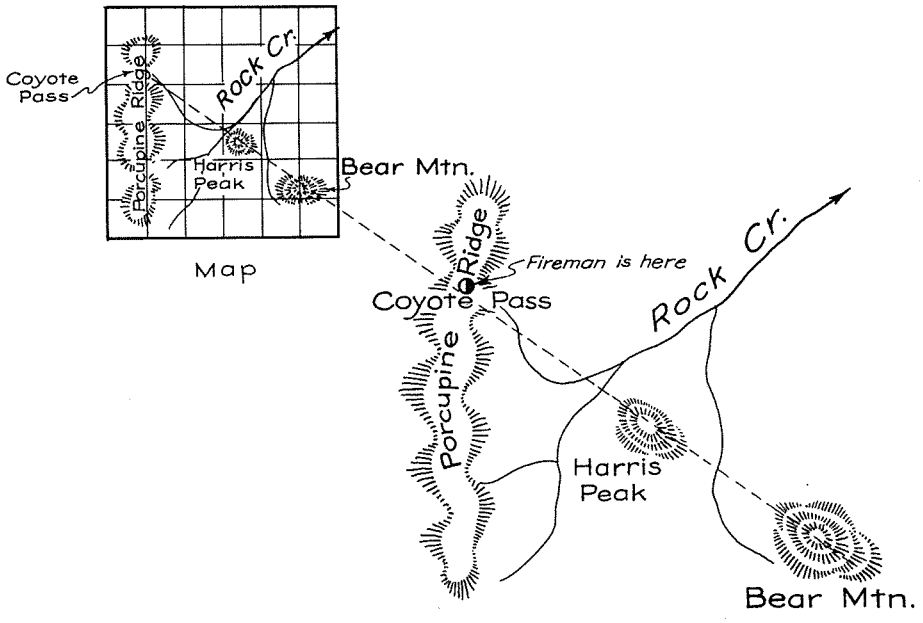


Fig. 73

Condition...

Fireman knows closely his location both on ground and map, and is familiar with certain prominent peaks, ridges, and other topographic features. See Fig. 73.

Action Required...

1. Lay map out flat with top of map in general northerly direction.
2. Fireman knows he is at Coyote Pass.
3. By looking around the country, he identifies a peak -- Bear Mountain.
4. He finds Coyote Pass and Bear Mountain on the map.
5. He shifts his map until, when sighting across the map location of both Coyote Pass and Bear Mountain, the line of sight passes through Bear Mountain.
6. The map is then oriented approximately, and the fireman is then able to locate other landmarks from his map.

Problem 4: Locating Position On Map By Means Of Topographic Features

Condition...

Fireman does not know his location on ground or on map. He notes in looking over the country that from where he stands Harris Peak and Bear Mountain are in line. (Refer to Fig. 73 .) He is also able to tell he is somewhere on Porcupine Ridge.

Action Required...

1. He finds on the map Porcupine Ridge, Bear Mountain, and Harris Mountain.

2. He then draws a straight line through Bear Mountain and Harris Mountain on the map, and extends it to intersect Porcupine Ridge on the map.

3. This line passes through Coyote Pass on Porcupine Ridge. The fireman's location is therefore at Coyote Pass.

4. His map can then be oriented by the method described in Problem 3.

USE OF TOPOGRAPHIC MAPS

A topographic map is a special type of map -- very useful to firemen in locating fires and in locating control lines on fires. The topographic contour map commonly used in fire-control work shows special features such as elevation, grades, and the shape or contour of the land with its ridges, peaks, and drainages. These are shown by means of contour lines. Each contour line represents a constant elevation on the ground surface. These lines may appear as more or less parallel or concentric lines -- see Fig. 74 . All points on the same contour are the same elevation. Other features are usually shown, too, including survey lines (section and townships), roads, trails, streams, lakes, and cities.

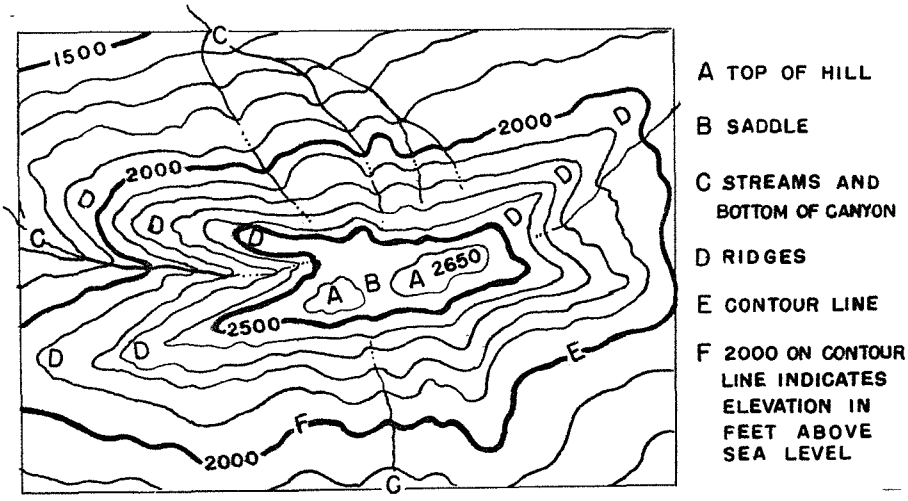


Fig. 74 Sample of Topographic (Contour) Map

The steepness of the topography is shown by the contour interval, or difference in elevation between the contour lines. The elevation of certain contour lines is marked on all contour maps.

To learn to use a topographic map you will need to become familiar with the following terms and features:

1. A contour line is an imaginary line representing a constant elevation on the ground surface.

2. A contour interval is the vertical distance or difference in elevation between contours.

3. Widely separated contour lines indicate gentle slopes.

4. Close contour lines indicate steep slopes.

5. Merging contour lines indicate very steep slopes, banks, or cliffs.

6. Contour lines point downhill on ridge tops. Sharp contour points indicate pointed ridges and rounded contour points indicate wider or broader ridges.

7. Contour lines point uphill or upstream where they cross drainages, and a sharp narrow "V" indicates a narrow canyon or ravine. A rounded contour line indicates a flatter or wider drainage.

8. Approximate elevation can be figured for any point on a contour map.

HOW FIREMEN LOCATE FIRES

Fires often start in remote areas, away from roads or trails -- particularly lightning fires. Then fires are tough to find, especially if they are small or in an area that cannot be seen from the road. Here are some of the methods you can use in getting to the "hard to find" fires.

THE COMPASS IN FIRE CONTROL

To find a fire you must know:

the direction to the fire, and
the distance to the fire.

The direction to be traveled to reach a fire away from a road is usually determined by a compass. Distance which must be covered on foot is generally measured by pacing.

The Azimuth Compass is best for determining directions in fire-control work. An azimuth compass is one which is graduated with a full circle of 360 degrees (360^{o}) called an Azimuth Circle. Numbering of the circle begins with zero (0^{o}) which is North, and proceeds clockwise.

90^{o} is east, 180^{o} is south, 270^{o} is west and 360^{o}, the same as zero is north, which completes the full circle. This circle is used to measure Azimuth -- the angle measured clockwise between any line and true north.

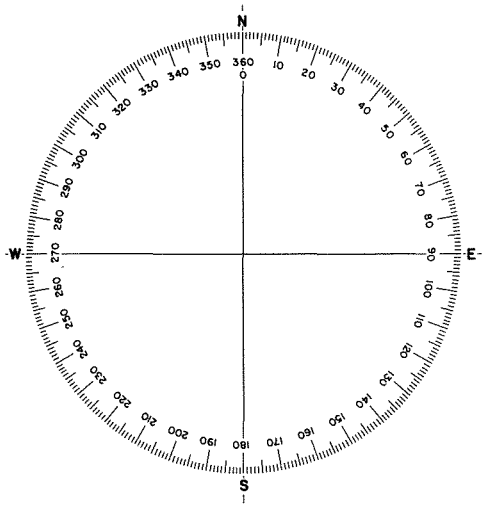


Fig. 75 Azimuth Circle

Two types of compasses are in general use in Forest Service work, the Forest Service Box Compass and the Silva Compass (see Figs. 77, and 81a and 81b.)

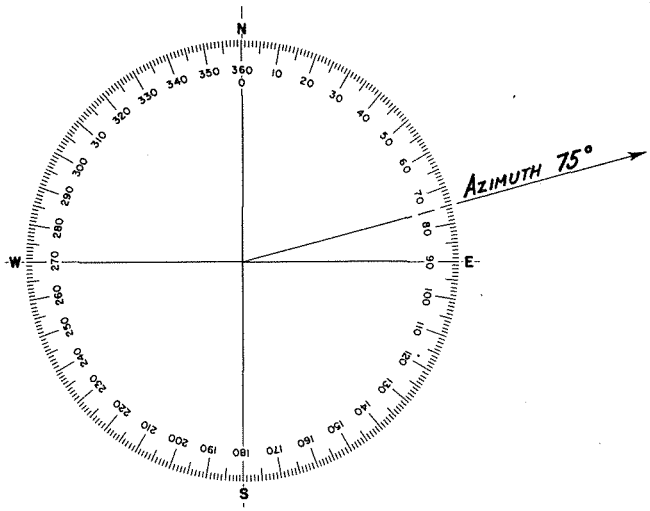


Fig. 76 Azimuth (or Azimuth Angle)

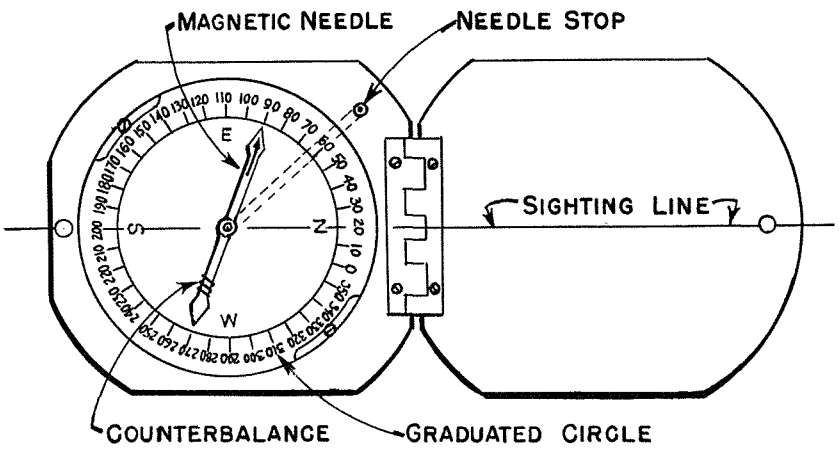


Fig. 77 Forest Service Box Compass

Forest Service Box Compass

The essential parts of this compass and their functions are: A magnetic needle that points to magnetic north and from which true north is determined; a graduated circle for laying off angles from true north; and a sighting line for prolonging a line of sight while following a course of direction. The counterbalance (a coil of fine wire) on the south end of the needle is to compensate for the pull of the earth's magnetism on the north end of the needle. The north end of the needle is usually marked with a small arrow.

NOTE: The graduated circle, (Azimuth circle) on the Forest Service Box Compass is marked counterclockwise, in order that the direction of the line of sight (Azimuth) is indicated on the azimuth circle by the north end of the needle. For example (Fig. 77), when the sighting line is pointed toward the east, the north end of the needle points to 90°, or east.

Magnetic Declination...

Directions in fire-control work always refer to true north, but the compass needle always points toward magnetic north, which is somewhat east of north in California. The difference between true north and the magnetic north is called magnetic declination, or simply the declination. It varies from 15° to 20° east of north in the various parts of California.

Adjusting The Forest Service Box Compass For Magnetic Declination...

By adjusting the graduated circle (azimuth circle) on the compass to compensate for the declination the sighting line will point to true north when the north end of the needle points to "0" or north on the graduated circle. This adjustment has already been made on the diagram of the Forest Service Box Compass (Fig. 78). The declination within a ranger district varies so little that it is considered to be constant. Therefore, once the proper declination is set off on the compass it need not be changed as long as the compass is being used in one district.

Problem 5: Adjust Forest Service Box Compass For Magnetic Declination

Condition...

Set off a declination of 18° E. on a standard Forest Service Box Compass.

Action Required...

1. Loosen the set screws.
2. Turn the azimuth circle to the right until the 18° mark is in line with the sighting line inside the cover.
3. Tighten the set screws.

Why...

When the needle settles to magnetic north and you turn the compass so the zero azimuth meets the needle, the sighting line points to true north.

Supplemental Action...

Your District Ranger can tell you the amount of the magnetic declination in your area.

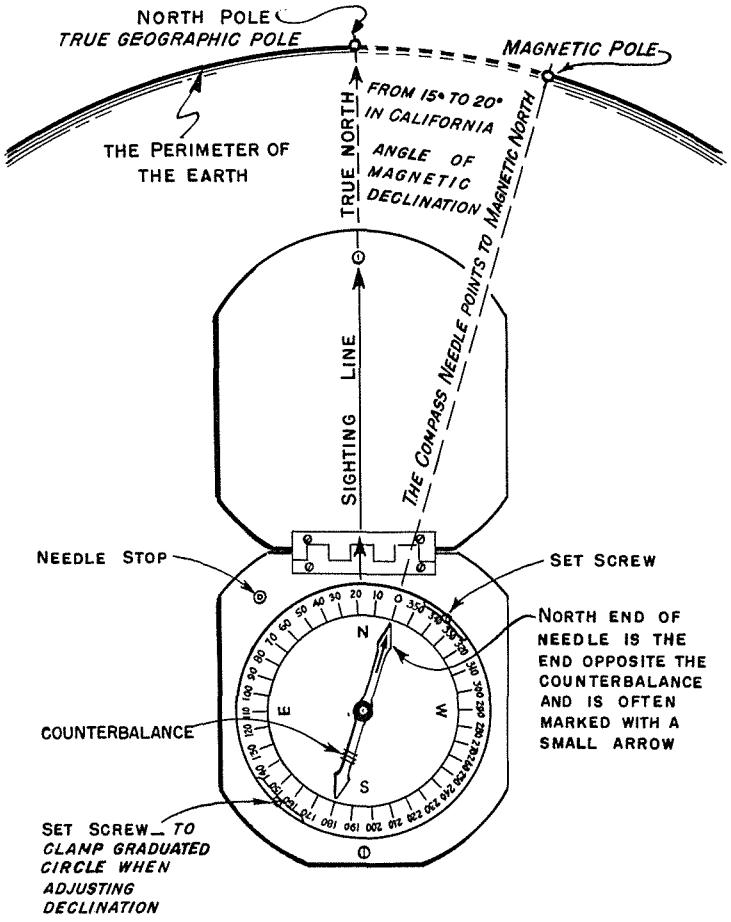

NORTH POLE
TRUE GEOGRAPHIC POLE
MAGNETIC POLE
THE PERIMETER OF THE EARTH
TRUE NORTH
FROM 15° TO 20° IN CALIFORNIA
ANGLE OF MAGNETIC DECLINATION
THE COMPASS NEEDLE POINTS TO MAGNETIC NORTH
SIGHTING LINE
NEEDLE STOP
SET SCREW
NORTH END OF NEEDLE IS THE END OPPOSITE THE COUNTERBALANCE AND IS OFTEN MARKED WITH A SMALL ARROW
COUNTERBALANCE
SET SCREW — TO CLAMP GRADUATED CIRCLE WHEN ADJUSTING DECLINATION

Fig. 78 Magnetic Declination and the Compass

How To Use The Forest Service Box Compass...

The proper way to stand while using the compass is illustrated in Figures 79 and 80 .

Fig. 79 Holding the Compass
Hold the compass in both hands with your elbows firmly against your sides and with your weight evenly distributed on both feet.

Fig. 80 Prolonging the Line of Sight
Look along the sighting line and then raise your eyes to prolong the line of sight ahead. Do not move your head; raise your eyes.

The steps to be followed in using the compass after the correct declination has been set off are:

1. Stand over the starting point and face in the direction that the line of sight is expected to take. For example, if the course of the line being followed is due south, face as nearly south as possible before opening the compass and freeing the needle.

2. Hold the compass in both hands with the left thumb over the needle stop and the elbows held firmly against the sides of your body.

3. Always hold the compass level.

4. Throughout the entire reading and sighting operation the compass should remain motionless.

5. In bringing the north end of the needle to the desired position on the graduated circle the entire body should be swung around slowly and the feet should be moved if necessary to keep the body facing the line of sight. Stand with your weight evenly distributed on both feet.

6. Use the needle stop to lessen any excessive swinging of the needle.

7. When the north end of the needle has come to rest at the correct position on the graduated circle, look along the sighting line, and then by raising your eyes prolong the line of sight.

8. Take note of one or more objects, such as a tree or a rock, along the line of sight.

9. Close the compass while it is in this position and put it away. This practice prevents injury to the needle and pivot and also saves time when the next sight is taken as it leaves the needle pointing to the bearing of the line being followed.

10. Walk to the most distant object noted along the line of sight and then take another sight with the compass.

11. Warning: Belt buckles, mechanical pencils, or other objects containing iron or steel, if allowed too near the compass while taking a sight will influence the position of the needle and can throw you far off course.

Problem 6: Follow An Azimuth Using A Forest Service Box Compass

Condition...

Travel on a 90° azimuth, using a F. S. Box compass to obtain direction.

Action Required...

Face approximately east. Holding the compass level, turn slowly until the north end of the needle points to 90°. Prolong the line of sight and note one or more objects along its course. Close the compass and proceed along the line of sight until you reach the most distant object sighted. Take another sight, repeating the above procedure as often as needed to follow the 90° Azimuth.

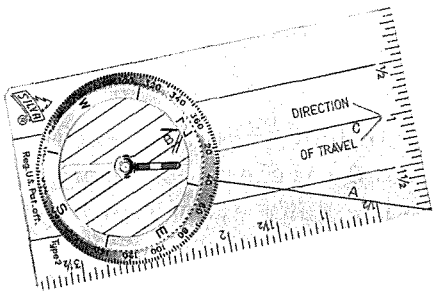


Fig. 81 a
"Voyager"

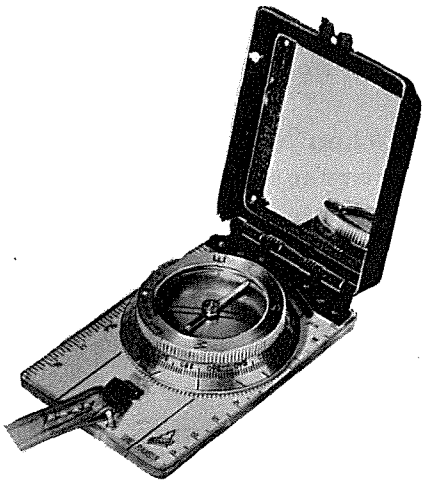


Fig. 81 b
"Ranger"

THE SILVA COMPASSES

A - "Azimuth line"
B - "Etched needle box"
C - "Direction of travel arrow"

The Silva Compass

The Silva Compasses, the "Voyager" and the "Ranger", are simpler to operate than the Forest Service Box Compass. Other than difference in appearance the main difference between the Forest Service Box Compass and the Silva Compass is that the azimuth circle on the Silva compass is graduated in a clockwise direction beginning with 0° at the north. In

using the Silva compass, disregard the azimuth circle on the plastic base. Use the azimuth graduations on the aluminum dial.

Adjusting Silva Compass For Magnetic Declination...

The north end of the needle is painted red, and points to magnetic north rather than true north, the same as in the Forest Service Box Compass. The adjustment for magnetic declination can be made in the following manner on the Silva compass.

1. Set the 360^{o} (or 0^{o}) azimuth on the "direction of travel" arrow, C, on the Voyager Model, or on the index pointer on the Ranger model.

2. Opposite the correct declination for the ranger district on which the compass will be used, scratch in line A into the plastic base as shown in photo Fig. 81a. This is called the "azimuth line," A.

3. Ink the scratch line, "azimuth line", with black or red india ink to make it stand out.

Once the proper declination has been set off on the compass it need not be changed again provided the compass is always used in the same ranger district.

How To Use The Silva "Voyager" Compass...

1. Set the desired azimuth (on aluminum dial) on the "azimuth line" (A).

2. Hold the compass in front of your body in the usual manner (see Fig. 79.) with the "direction of travel" arrow (C) pointing directly ahead of you.

3. Turn your body (and compass) until magnetic needle is centered in the "etched needle box" (B) inside the compass housing.

4. Follow the "direction of travel" arrow (C). This is your desired course or azimuth.

How To Use The Silva "Ranger" Compass...

1. Set the desired azimuth (on aluminum dial) on the "azimuth line" A.

2. Hold the compass horizontally on a level with your sighting eye and adjust the cover so the reflected image of the compass housing fills the mirror. (See Fig. 82 and 83.)

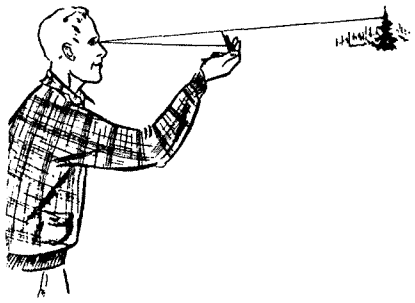
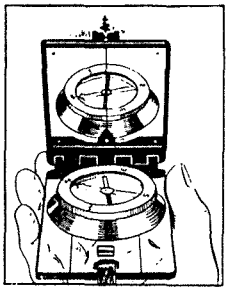


Fig. 82
Sighting with the "Ranger" Compass.

Fig. 83
Aligning sighting line with center point of "Ranger" Compass.



3. Move your sighting eye sideways in relation to the compass until the sighting line intersects the reflected image of the center point. (See Fig. 83.)

4. Without changing the relationship between compass and eye, turn your body until the north (red) end of the compass needle points to the azimuth line (declination line) on the compass base, and the needle is centered in the etched needle box inside the compass housing.

5. Your direction of travel (or objective in the field) will now lie straight beyond the sight on the upper edge of the cover.

   (When sighting uphill or downhill you must lower or raise the sighting eye in relation to the compass. The transparent plate must always be kept horizontal so that the compass needle can turn freely.)

Problem 7: Follow An Azimuth Using A Silva Compass

Condition...

Travel on a 90^{o} Azimuth, using a Silva Compass to obtain direction.

Action Required...

1. Set 90^{o} on the aluminum dial opposite the azimuth line "A".

2. Hold the compass in front of you, with the direction of travel arrow "C" pointing directly ahead of you.

3. Turn slowly until the magnetic needle is centered in the etched needle box "B" inside the compass housing.

4. Sight along the direction of travel arrow "C" and slowly raise your eyes. Note one or more objects along your line of sight. Proceed along the line of sight until you reach the most distant object sighted.

CAUTIONS To Be Observed In Using A Compass...

a. Be sure that the correct declination is set off on the compass.

b. When running lines always follow the line of sight and not the direction of the needle.

c. The compass is a delicate instrument; handle it carefully.

d. Always follow the line indicated by the compass rather than relying on your judgment as to the direction.

e. Remember the object (tree or rock, or other object) sighted on your line of sight. When in doubt take another compass reading.

f. Keep articles containing steel or iron sufficiently far away from the needle to avoid influencing it.

g. Do not attempt to repair the compass except in emergencies. Take it to your Ranger for attention.

Figuring Back Azimuths For Backsighting

While following a line of sight or an azimuth you may sometime lose the landmark (tree or rock) you are following and find it necessary to check your location to determine if you are still on the correct line of sight or azimuth. To do this you can sight back toward your starting point and then check with your compass to see if you are still on the line. This requires sighting a back azimuth which is in the opposite direction from the azimuth. Since there are 360 degrees in the azimuth circle, the opposite direction would be half of 360°, or 180°, difference from the azimuth. A back azimuth is calculated by adding 180° to the azimuth when the azimuth is less than 180°, or by subtracting 180° from the azimuth if it is more than 180°.

Example: See Figure 84.

The north end of the needle indicates the azimuth which in this case is 90°, or east. The back azimuth is in the opposite direction so it would be 90° plus 180° which is 270° or west.

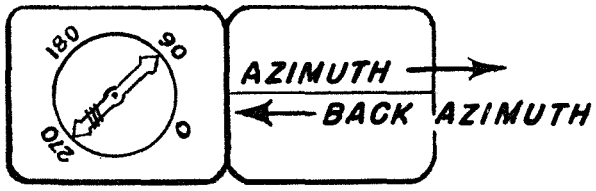


Fig. 84

Problem 8: What is the back azimuth of 45°?

Solution: Add 180° to 45°.
Result: 225°
Why: Since 45° is less than 180°, it is added to 180°.

Problem 9: What is the back azimuth of 200°?

Solution: Subtract 180° from 200°.
Result: 20°
Why: Since 200° is over 180° you subtract 180° from it. (Adding 200° to 180° would give 380°. Since there are only 360° in a circle we have exceeded the circle by 20° -- 380° - 360° = 20° -- which again is the back azimuth.

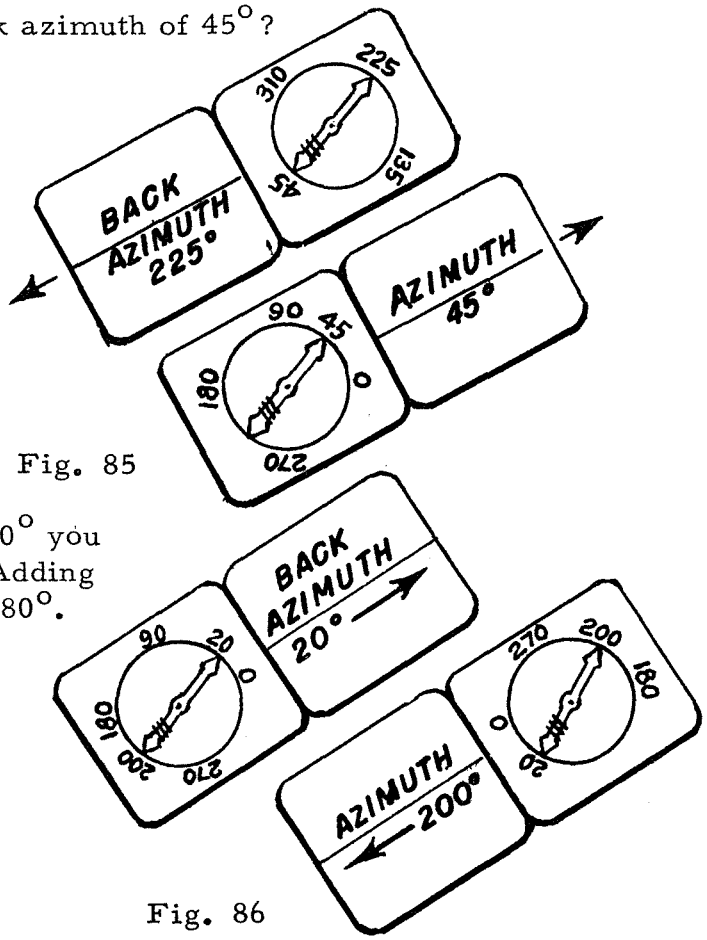


Fig. 85

Fig. 86

Backsighting

Using a back azimuth to check a line of sight or to sight back on a starting point or lookout point is called back sighting.

Getting On Line

It is not always possible to keep the lookout point or your starting point in view when traveling to a fire. When you reach a point where the lookout or your starting point can be seen and you wish to get on line between the lookout point and the fire, proceed as follows:

1. Face general direction of backsight.

2. Hold the compass firm and level as described previously.

3. a. (F. S. Box Compass) Turn compass so north end of needle rests on back azimuth reading.

   b. (Silva Compass) Set back azimuth (on the aluminum dial) on the azimuth line.

4. a. (F. S. Box Compass) When the needle has settled on back azimuth, sight along sighting line on compass.

   b. (Silva Compass) When the needle is centered in the etched needle box, sight along direction of travel line.

5. Note on which side and the approximate distance the line of sight misses the lookout point.

6. If lookout point is to the right of line of sight, you must move to the right. If lookout point is to the left of line of sight, you must move to the left.

7. Estimate the distance that the line of sight misses the lookout point. Move over this distance, either to the right or to the left as required. Take another backsight on the lookout point. Repeat this procedure until the line of sight passes through the lookout point.

8. You are then on line between the lookout point and the fire and can turn the compass to the azimuth reading and proceed along the line toward the fire.

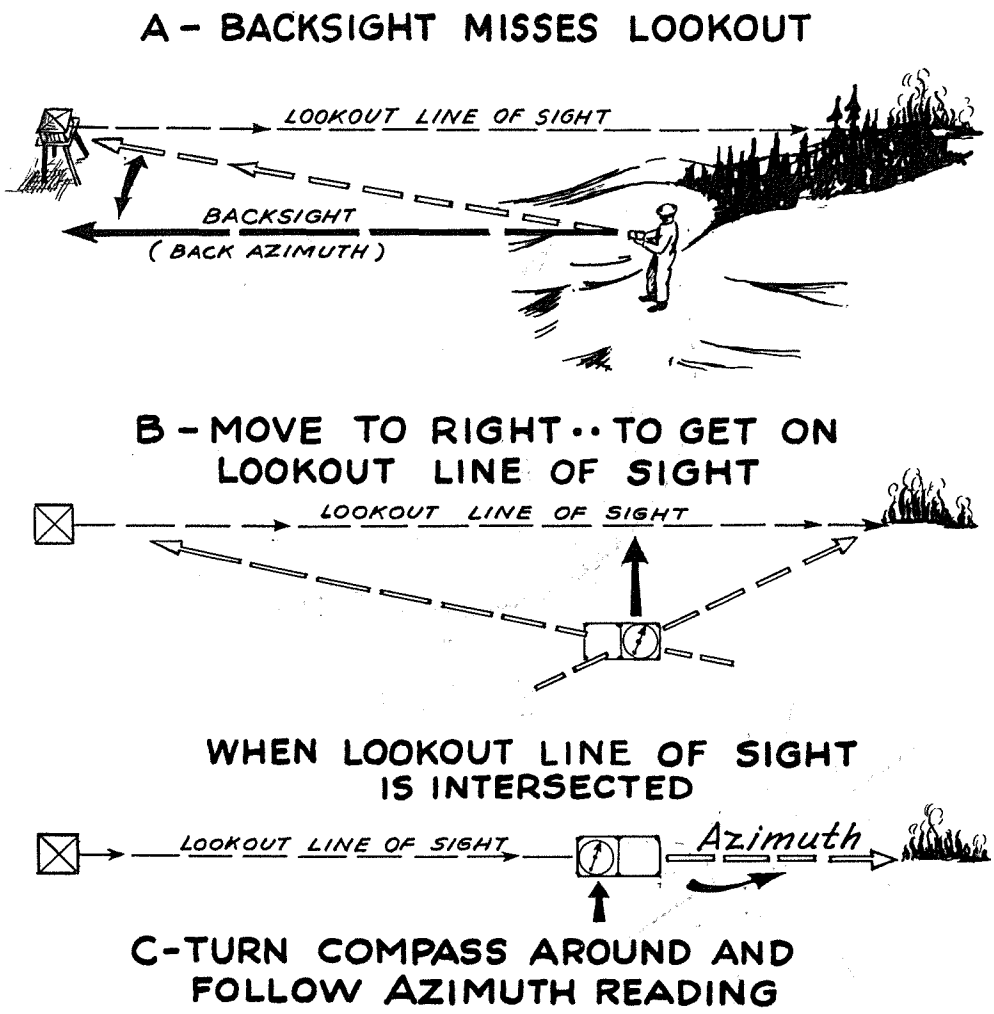

A - BACKSIGHT MISSES LOOKOUT
LOOKOUT LINE OF SIGHT
BACKSIGHT
(BACK AZIMUTH)
B - MOVE TO RIGHT •• TO GET ON LOOKOUT LINE OF SIGHT
LOOKOUT LINE OF SIGHT
WHEN LOOKOUT LINE OF SIGHT IS INTERSECTED
LOOKOUT LINE OF SIGHT
Azimuth
C-TURN COMPASS AROUND AND FOLLOW AZIMUTH READING

Fig. 87

Getting on Lookout's Line of Sight

Determining Direction By Aid Of Watch And The Sun

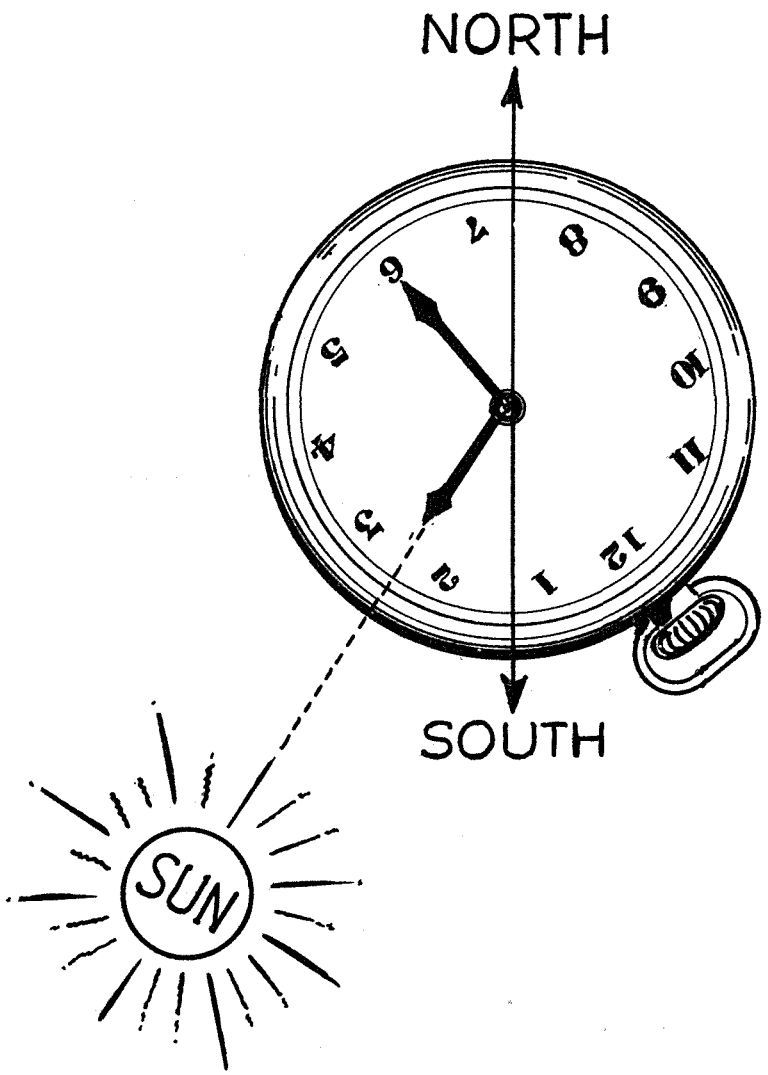


Fig. 88

1. Point hour hand at sun (using standard time).
2. Half way between sun and 12 o'clock is South. (Can be used only between hours of 0600 and 1800.)

PACING IN FIRE CONTROL

Pacing is the measuring of horizontal distance on the earth's surface by counting steps of a known length. With practice a man can attain accuracy sufficient for most field measurements needed in fire-control work.

The chain is the land surveyor's unit of linear measure. One chain equals 66 feet and is the basic unit for measuring distances in fire-control work. There are 80 chains in one mile.

A pace is the distance on level ground between the heel of one foot and the heel of the same foot where it next touches the ground while walking normally; that is, two normal steps.

Determining Paces Per Chain On Level Ground

Because the length of pace varies with the individual, it is necessary for each man to learn the length of his normal pace. In order to pace a given number of chains to a fire he also needs to know how many paces he takes to a chain.

Problem 10: Determining Length Of Pace

Condition...

To determine the length of your pace and how many paces you take to a chain in level, open country.

Action Required...

With a steel tape, measure a course of several chains on level ground. Mark each end with a stake. Walking normally from one stake to the other, count your paces. Divide by the number of chains in the course to get your paces per chain.

Why...

This one-chain pace-count, (paces per chain) when multiplied

by the number of chains to a fire, will give the number of paces to the fire in level open country. If you divide your one chain pace count into 66 feet, it will tell you how long each pace is.

Example -- Assume your measured course is 3 chains or 198 feet (66 x 3) and you find that you cover this distance with 36 of your normal paces. Therefore, your pace is $\frac{36}{3}$ or 12 paces per chain.

Each pace is 198 or 5 1/2 feet long.

Determining Paces Per Chain On Sloping Ground

Steepness of slope affects pacing in two distinct ways.

First, the natural length of step in walking or climbing up or down varies with the steepness of slope, so the number of paces per chain must change.

The second effect of steepness of slope is related to the fact that land surveys are based on horizontal distances, NOT slope distances. In order to measure a given horizontal distance -- for example, 1 chain -- a man must travel more than 1 chain when walking on a slope. This is equally true whether going uphill or downhill. The differernce between the horizontal distance and the slope distance becomes increasingly pronounced as the steepness of slope increases.

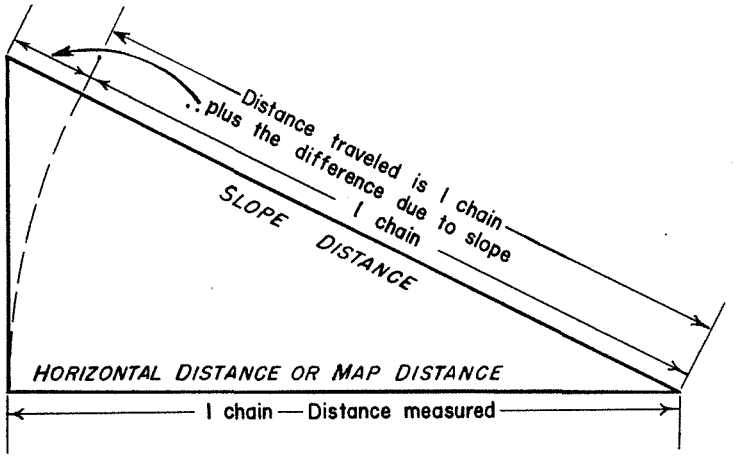

Distance traveled is 1 chain
∴ plus the difference due to slope
1 chain
SLOPE DISTANCE
HORIZONTAL DISTANCE OR MAP DISTANCE
1 chain — Distance measured

Fig. 89 Difference Due to Slope

When measuring distance to a fire, you may find several changes in slope. The distance traveled on the surface in measuring 1 mile is much greater than the horizontal distance. The allowance for slope or any other factor is usually made as each pace is covered so that a single pace count always indicates the horizontal distance covered. In other words, if a man uses 12 paces to cover a chain on level ground, each pace counted should equal 1/12 chain horizontal distance measured regardless of slope or any other factor.

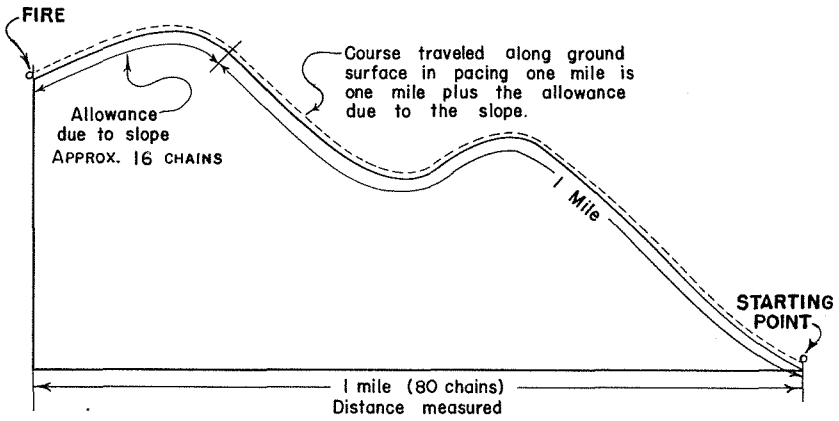

FIRE
Course traveled along ground surface in pacing one mile is one mile plus the allowance due to the slope.
Allowance due to slope
APPROX. 16 CHAINS
1 Mile
STARTING POINT
1 mile (80 chains)
Distance measured

Fig. 90 Allowance Needed Due to Slope

The allowance for slope is applied continually as the pacing progresses. The allowance that is needed will vary with the steepness of slope. The extra steps taken to cover the additional distance traveled due to slope are not counted.

Problem 11: Determine Paces Per Chain On Sloping Ground

Condition...

To determine how much to add to your pace count on slopes in order to measure horizontal distances by pacing.

Action Required...

Lay off a three-chain horizontal distance with a steel tape on a medium slope. This can be done by holding the tape level on each measurement and using a plumb bob on the

downhill end of each measurement. Mark both ends of the course. Using normal steps, pace upward on this course the number of paces you took to three chains on the level. Pace the distance remaining to the end of the course. The latter is the amount you must add to get level distance on a three chain distance traveling uphill. Divide this figure by three to get the amount for one chain. Divide the latter figure by your paces per chain to get the amount to add to each pace.

Example -- (refer to example in previous problem)

1. Fireman goes 36 paces.
2. Has 18 feet left to end of course.
3. $\frac{18 \text{ ft.}}{3 \text{ ch.}}$ = 6 feet per chain (addition per chain to get level distance)
4. $\frac{6 \text{ ft. ch.}}{12 \text{ paces/ch.}}$ = 1/2 foot per pace (addition per pace to get level distance)

Supplemental Action...

Repeat this process on the same course going downhill. Record all figures in notebook. Use them until you have acquired such skill in the pacing process that you no longer need refer to them. Also, add more slope correction on slopes steeper than your pacing course and less on gentler slopes.

Other Factors Affect Pacing

Human factors must be onsidered. A man's vitality may decrease during a day's work, after a poor night's sleep, or with illness, and as a result he is likely to shorten his step. A man's step is shorter when traveling slowly than when moving at his normal rate. On the other hand, he is likely to lengthen his step in the early morning, when he is in a hurry, or on gentle slopes after leaving rough country. All of these factors must be allowed for in pacing.

Dense reproduction, brush, bear clover, or a combination of these conditions increase the effort required for accurate pacing.

On loose, rocky, or swampy soils it is more difficult to pace than on firm soil, and allowance must be made for these conditions.

It is desirable to learn to estimate short distances; occasionally you will encounter a stream too deep to wade or a slope too steep to cross, and the distance must be estimated. Often in rough country or dense brush it is more accurate to estimate a short distance to some object than it is to pace the distance. First practice estimating in units of paces, and then increase the estimate to units of chains. In practicing, verify each estimate by pacing the distance. Continue practice until the desired accuracy is reached.

USE OF MAP AND COMPASS IN LOCATING FIRES

Problem 12: Following Lookout's Azimuth To Locate Fires

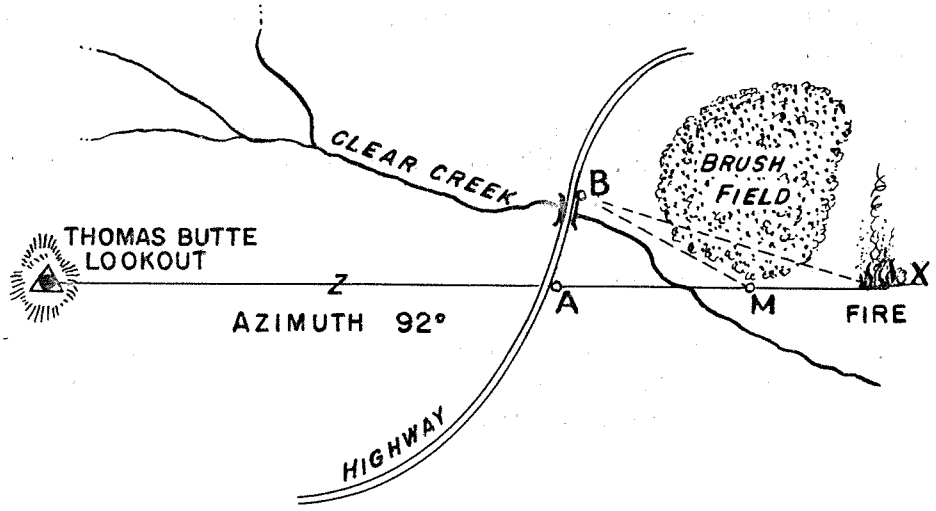


Fig. 91 Following Lookout's Azimuth

Condition...

Fire located at X by Thomas Butte Lookout, with cross shot from another Lookout. Generally flat country. Little smoke showing and probably will be hard to find. Fireman equipped with map and compass.

Action Required...

Fireman receives instructions from Dispatcher and takes the following action:

1. Spots fire on map, draws line on his map (see Fig. 91.) from lookout to fire and records azimuth of 92° from Thomas Butte and other instructions as given by Dispatcher.

2. Proceeds in his car to Clear Creek bridge, then paces back 20 chains to point A on road (distance was calculated by Dispatcher).

3. Proceeds on line of sight as determined by use of compass and known azimuth, (92°) paces 125 chains as calculated by the Dispatcher, to the fire.

Supplemental Action...

If fire were located at Z, (Fig. 91.) the fireman would determine the direction from A to the fire by using the back azimuth instead of the azimuth.

Problem 13: Following A Computed Azimuth To Avoid An Impassable Creek

Condition...

Same situation as in Problem 12, except Clear Creek can be crossed only on bridge.

Action Required...

1. Fireman receives instructions from Dispatcher and records same in notebook and on map.

2. Proceeds to bridge as in Problem 12.

3. Paces to fire on line B-X, using an azimuth of 101^{o} and distance (128 chains) as calculated by Dispatcher.

Problem 14: Avoiding Brush Fields By Using A Backsight

Condition...

Same situation as in Problem 13 (see Fig. 91.) except fireman finds brush field on line B-X to be impenetrable, but easily avoided.

Action Required...

Same as in Problem 13 to the bridge across Clear Creek. Fireman then paces down far bank of Clear Creek until he is able to get on line of sight as determined by a back sight azimuth of 272^{o} on Thomas Butte, Point M. He then proceeds on line of sight (azimuth 92^{o}) to fire, going a total of 130 chains. The additional two chains over the Dispatcher's 128 chains is his own estimate of the effect of the detour.

Problem 15: Avoiding Brush Field By Offsetting

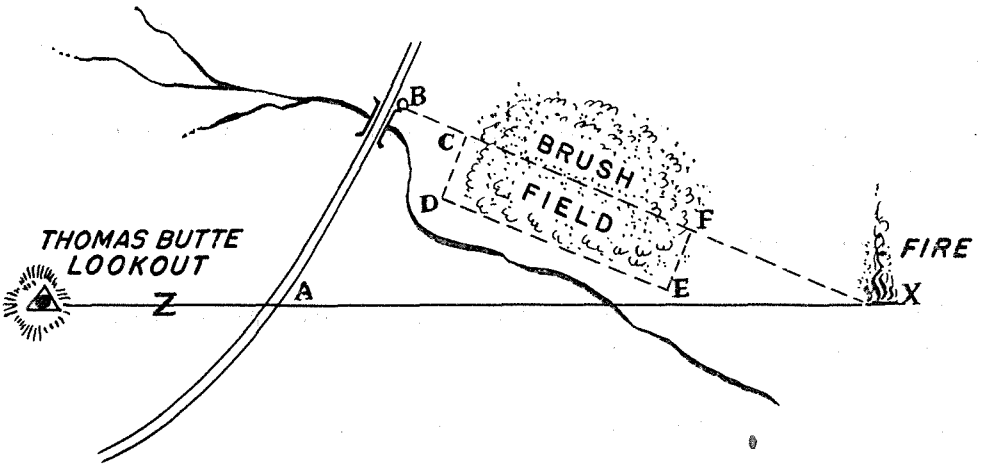


Fig. 92

Condition...

Same situation as in Problem 14, except Thomas Butte Lookout is not visible.

Action Required...

Same as in Problem 13 to the bridge across Clear Creek. Fireman paces toward brush field on line B to X (101^{o}). When he reaches brush field Point C, he makes right angle turn (90^{o}) on compass and paces on this course to Point D, counting number of paces. At Point D, makes right angle turn back to original azimuth (101^{o}) and paces to Point E, or until he can clear brush field. At Point E, turns right angle turn and paces to Point F, using same number of paces as in Point C to Point D. At Point F, turns right angle azimuth (101^{o}) and paces remainder of the distance to X.

Problem 16: Locating Fire By Means Of Back Azimuth Or Back Sight

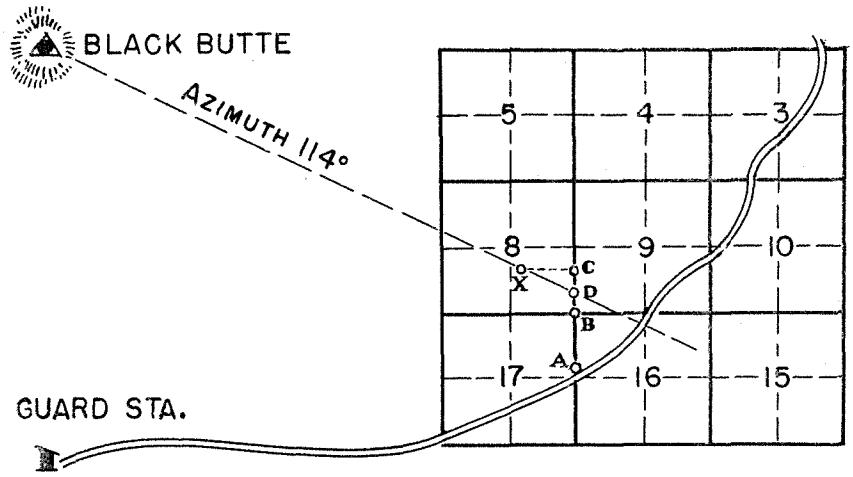


Fig. 93

Condition...

Fire located at X by Black Butte with cross shot from another lookout. Small fire probably difficult to find.

Action Required...

Fireman receives information from dispatcher and carries out following action:

1. Marks location of fire and Black Butte Lookout's line of sight on his map. Writes down azimuth (114°) and back azimuth (294°) and instructions.

2. Drives to marked roadside Point A, which is on line between Sections 16 and 17 (point is marked on roadside by section line marker).*

*Location posters such as Section Corner markers and section line markers, where a road, trail, or stream crosses a Section Line, are described in this chapter under "Public Land Survey" in the paragraph headed "Location Posters". See Figures 70 and 71 on pages 86 and 87.

3. Proceeds due north, pacing 38 chains to Section corner* at B.

4. Paces due north 19 more chains to D. This puts him on Black Butte Lookout's line of sight (Azimuth 114°).

5. Uses back azimuth (294°) and paces 40 chains to fire. NOTE: Approximate distance computed from map.

Alternate Action...

Paces due north 38 chains from B on line B-C, thence due west 33 chains from Point C to the fire.

*See footnote on page 117.

Problem 17: Locating A Fire By Means Of Two Backsights

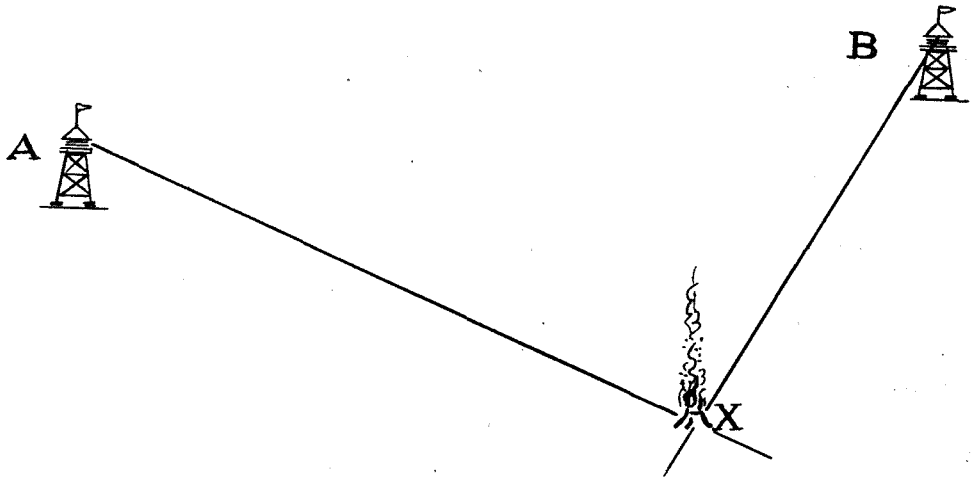


Fig. 94

Condition...

Fireman has been dispatched to fire at X, (see Fig. 94.) located on map by intersection of Azimuths from Lookouts A and B. Has full record of instructions, including map. Has become confused enroute, can't find fire, and needs to check his location. Topography level. Can see both lookouts.

Action Required...

1. Sets up compass and backsights onto Lookout A, changing position until correct back azimuth is read.

2. Proceeds similarly with Lookout B, keeping always on line of sight from A.

3. When both backsights check with the back azimuths given him by the Dispatcher, he will be at the fire.

USE OF RADIO EQUIPMENT AND SIGNALING MIRROR IN LOCATING FIRES

Problem 18: Using A Signaling Mirror And A Portable Radio To Locate A Fire

Condition...

Fireman cannot locate fire. He is in an area visible to the Lookout who reported fire, and he is equipped with signaling mirror and portable radio.

Action Required...

Fireman talks to Lookout by portable radio, indicating his location by signaling the Lookout by flashing with his mirror. When the Lookout sees the mirror flash he tells the fireman the direction and distance he must proceed to reach the fire. This action may have to be repeated several times.

Alternate Actions...

Any type of mirror can be used -- e.g., rear view, or side view auto mirror.
If fireman has no mirror, or sun is not in suitable position to use a mirror, he can build a signal smoke to show his location -- being certain to completely extinguish the fire before leaving it.
At night the fireman can use his headlight to signal the Lookout.

Problem 19: Using A Portable Radio And Signaling Mirror To Locate A Fire Spotted By An Airplane

Condition...

Fireman cannot locate fire. Reconnaissance plane in vicinity is equipped with radio. Fireman equipped with signal mirror and portable radio.

Action Required...

Fireman established radio contact with plane. Then signals plane with mirror to show his location. Plane observer directs fireman to the fire by radio.

ALTERNATE ACTIONS IN LOCATING FIRES

If fireman has no mirror, or the sun is in the wrong spot, the fireman can make his location known in other ways:

a. Build signal smoke.
b. Make a display of conspicuous material -- a white undershirt, colored markers of bright paper or cloth, or hard hats painted a highly visible color. It helps to display such signals from a tree, if possible.
c. Use the radio to tell the plane observer where to look. Describe location by landmarks or position relative to the plane at a given time.
d. If fireman has no radio and cannot find fire, he can signal plane in some way until the observer sees him. The plane will then fly directly from fireman's location to fire, circle the fire several times, and repeat the maneuver. Or the observer may drop toilet paper when he is directly over the fire. Both roll type and leaf type are useful. With the latter, it is particularly important that the plane be visible to the fireman when the paper is dropped.

SUGGESTED AIDS IN FINDING SMALL FIRES

When the fireman reaches the spot where he has determined that the fire should be, he may not always find the fire immediately. The fire may be in some obscure spot or be too small to be readily seen. In such an event the fireman should mark the spot or locate a landmark so he can return to the spot, and then use one of the following aids in finding the fire.

Gridiron or crisscross area where you think the fire is.
Climb a tree.
Go to a high point.
Go to opposite hillside.
Smell for smoke -- remember that drafts are usually up-slope during day and down-slope at night.
Shout. Someone may be on the fire ahead of you and his work on it has caused it to smoke no longer.
Do not overlook fires which may be burning in tree tops or forks of trees.
Smokes can generally be seen more easily when looking into the sun.

MEASURING BURNED AREAS

Area and perimeter are computed on all fires. The fireman may sometimes be required to do this. The common Units of measurement are: 1 Chain = 66 feet; 10 Square Chains = 1 acre; 43, 560 Square Feet = 1 acre. Long narrow fingers should be measured separately when computing total area. Area of Spot Fires should be added to the size of the main fire. All fire acreage should be computed by horizontal measurements.

Problem 20: Determining Acreage Of A Small Fire

Condition...

Fireman has been requested to determine acreage of a small fire.

Action Required...

The fireman, after his crew has mopped up the fire, walks around and through it to size up its general shape. While doing this, he keeps in mind that he wants to get its average dimensions by pacing the dimensions of the fire. This information is to be entered on his fireman's fire report.

(See Appendix 7 for copy of Fireman's Report - Form 144 R-5.) Fireman draws a rough sketch of the shape of the fire on a notebook sheet, thus:

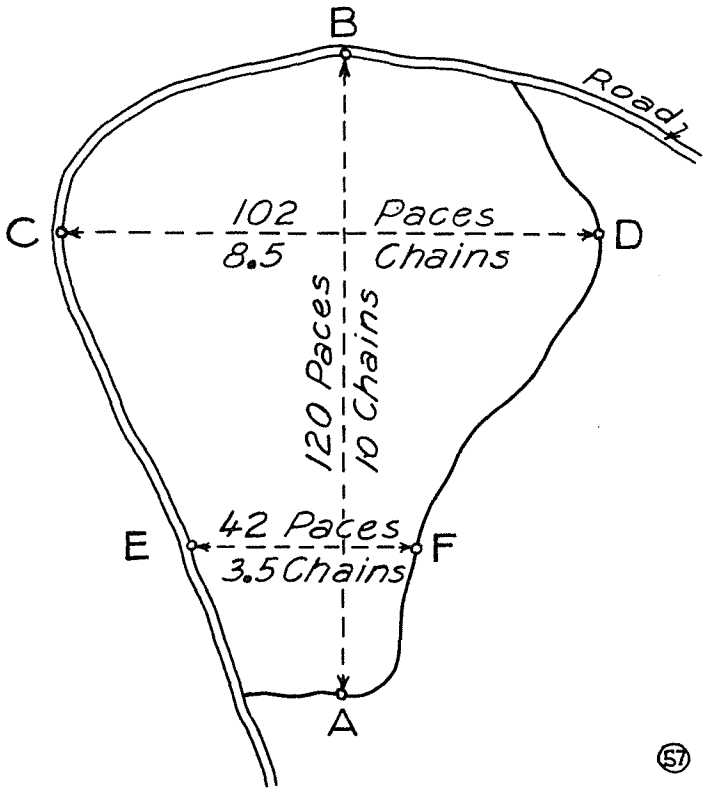


Fig. 95 Measuring Burned Area

He decides that the length of the fire is about the same any way it might be measured, so he paces the length along the line A-B. He records the number of paces on his sketch, and the distance which, IN THIS CASE, is 10 chains. He then paces across the widest part of the fire approximately at right angles to his lengthwise paced distance; and records 8.5 chains, as indicated by line C-D on the sketch. Moving to the narrowest end of the fire, he paces this distance and gets 3.5 chains, which he records for the distance E-F. He then uses the following steps to determine the area:

1. The average width equals the sum of the two measurements divided by 2.

   3.5 chains = width of fire at E-F

   8.5 chains = width of fire at C-D

   12 chains = sum

   12 ÷ 2 = 6 chains, average width

2. The area in square chains equals the average width times length.

   6 chains = average width from step (1) above.

   10 chains = length

   6 x 10 = 60 square chains

   60 ÷ 10 = 6 acres

REVIEW QUESTIONS AND EXERCISES ON USE OF COMPASS; LOCATING FIRES; MEASURING BURNED ACREAGE

1. Take your compass outdoors. Stand at a definite, well-marked point which you can locate again at a later date. Sight an azimuth of 290°. Locate some distinctive object on this azimuth. Make a note of it. Get your Ranger or Fire Control Assistant to check you on it the next time he stops in.

2. Stand at a definite, well-marked point. Pick out a definite object some distance away. What is the azimuth from you to the object? Get your Ranger or Fire Control Assistant to check you on it the next time he stops in.

3. Figure the backsight (back azimuth) of the azimuth. Write it down. Take the compass to the object and sight the back azimuth. Were you right?

4. Look at your compass. At what declination is it set now? Suppose it is set at zero. What three things are done to set the Forest Service Box Compass at 18° E? What is done to set the Silva Compass at 18° E?

5. Determine north with your watch and the sun. Check it with your compass.

6. Get out on a ridge where you can look across a canyon. Pick out some object on the other ridge which:

   a. You can identify when you get there, but which
   b. You cannot see from the canyon bottom.

   Determine the azimuth from you to the object with your compass. Use the compass to go directly to the object. If you missed, try again.

7. Your back azimuth falls to the left of the Lookout. Which way do you go to get it on the azimuth?

8. How may a map be oriented without use of a compass? Try it with your map.

9. Explain how a fireman can determine his location on the ground with a map only. (no compass)

10. What is the legal map-description of the location of your station?

11. You have trouble finding the fire. There is a plane observer overhead. He can see the fire. What does he have to know before he can direct you to the fire? Name two ways in which you can get this information to him.

12. When you are near a fire, but cannot find the fire immediately, what five things can you do to find the fire without aid of map or compass.

13. How many paces (yours) in one chain? How many steps in one pace? How many feet in a chain? How many square chains in one acre?

CHAPTER III

LOOKOUT DUTIES

LOOKOUT DUTIES

INTRODUCTION

Forest Lookouts are the eyes of the Protection Organization. Seeing a fire or smoke and reporting rapidly and accurately what is seen is the beginning of suppression work on every fire.

This chapter covers information to lookouts on "How To Do Your Job". General items which also concern lookouts are covered in other chapters. Some of these items are housekeeping, safety, public contacts, and communications. Lookout-firemen will also refer to the suppression chapter.

ESSENTIAL QUALIFICATIONS OF YOUR JOB

To do a good job, you must have some special qualities:

Good health.
Good eyesight.
Interest in your job.
Ability to live in isolated locations for long periods of time.
Ability to read maps, use firefinder, use radio, and use other tools of your job.
Be capable of clear, cool thinking in an emergency.

LEARNING YOUR COUNTRY

It is essential that you know the location and names of the topographic features of the country which you see. You will refer to these local landmarks in reporting the location of smokes. Some of these landmarks are peaks, streams, roads, buildings -- any feature which may be used to describe a location.

You should acquire a basic knowledge of these local landmarks as quickly as possible. Study the country until confident that you know all its features. You must be able to locate accurately on the map, and describe by local name, landmarks of any point in your country.

HOW TO SYSTEMATICALLY LEARN COUNTRY SEEN FROM LOOKOUT

1. Pick out prominent landmarks, peaks, streams, and buildings.
2. Learn their names, from map, or by asking questions. Ranger or Dispatcher will assist.
3. Use firefinder to locate them on map.
4. Identify other landmarks by referring to these known points.
5. Observe car dust to locate road locations.
6. The legitimate smokes from sawmills, industrial plants, and residences may show their locations.
7. Mirror flashes from field personnel can give you definite locations on the ground. Arrange with the Dispatcher for help of this kind. Description of location will be given to you by radio or telephone.
8. Travel through as many different parts of your territory as possible on your way to and from the lookout. Look back toward the lookout tower frequently; this will help you get the lay of the land.

HOW TO IDENTIFY A LANDMARK BY USE OF THE FIREFINDER

1. Set firefinder sights on the landmark.
2. Study topography along line of sight. (The tape crosses the same objects on the map as appear along the line of sight.)
3. Working from known topographic features, the location of the landmark can be determined on the ground as well as on the map, even it the name is not given or known.

HOW TO KEEP A RECORD OF LANDMARK LOCATIONS

You will keep a record of three kinds of landmarks:

1. Orientation Points

   Your orientation point is a landmark used to orient your firefinder and to check its adjustments daily.

The azimuth of your orientation point will be posted at your station.

2. Legitimate Smokes

Permanent and periodic smokes such as:

Sawmills	Campgrounds
Refuse dumps	Railroads
Residences	Logging operations
	Industrial operations

3. Key Points

Any location which will help you know your country and may be useful in describing other locations. These may be:

Peaks, saddles, ridges, canyons
Streams, lakes, waterfalls, dams
Points on roads or trails
Locations of heavy human use or high hazard

Several types of forms, as well as a file card system, have been developed to record these landmarks. Your Ranger will show you the form to use. A sample of one type of form is shown on next page.

Use Of The Form, "Orientation Point, Legitimate Smokes and Key Points"

The columns for this form will be filled in as follows:

Place Name: Give the name of the Orientation Point (e.g., Pinnacle Point), Legitimate Smoke (e.g., Burton Mill), or Key Point (e.g., Payne's Peak).

The Azimuth and Vertical Angles are recorded in the second and third columns.

Smoke Base or Point Visible from Lookout. Record "yes" or "no". The smoke from some legitimate source such

Form 312-R5

ORIENTATION POINT
LEGITIMATE SMOKES AND KEY POINTS

LOOKOUT STATION High Mountain OBSERVER Hugh R. Lowe DATE June 1, 1954

Place Name	Azimuth Reading	Vertical Angle	Smoke Base or Point Visible from Lookout?	Elevation	Remarks: Significant description or information State whether orientation point, legitimate smoke, or key point.
Burnt Peak	15° 45'	-3° 30'	Yes	6,245	Orientation Point
Sunset Point	271° 15'	-4° 30'	Yes	5,892	Alternate orientation point
White Pine Sawmill	2° 30'	-6°	Yes	4,300	Legitimate smoke
Butteville Rubbish Dump	9° 00'	-6°	Yes	4,340	" "
					" "Mill closed down 7/15
Indian Cr " Sawm "	185° 30'	-5° 30'	No	4,250	" " Smoke rises beyond Squaw Ridge
King Sole in Mi	245° 45'	2° 30'	Yes	4,800	" " occasional dust - looks like smoke
Western Cons. Co. Pla	280° 00'	-4° 30'	Yes	4,050	" " Till about Aug. 30. Road Resurfacing Mix Plant
Boonesville Dump	315° 00'	-1° 30'	No	4,600	" "Smoke rises thru Cedar Pass
Granite Knob	5° 30'	+1° 30'	Yes	7,608	Key Point
Butteville	8° 30'	-6°	Yes	4,340	Key Point (Lights visible at night)
Manzanita Lookout	51° 15'	+30'	Yes	7,345	Key Point
Indian Creek Dam	183° 30'	-5° 30'	Yes	4,250	Key Point
Taylorville	187° 30'	-5° 30'	No	4,250	Key Point - Saw from lights visible at night
Bucks Saddle	220°	-30'	Yes	6,800	" " Summit of Indian Creek Hwy.

-130-
Fig. 96

as a mill, may not be seen until it rises above a ridge, or the glow of the lights of a town may be visible at night although the lights cannot be seen directly.

Elevation: Record the approximate elevation of the point or smoke.

Remarks: State whether the point listed is a Key Point, Legitimate Smoke or Orientation Point, and give a brief description or pertinent information regarding the point.

Two general systems are used in recording your Orientation Point, Key Points, and Legitimate Smokes: one is to record them in sequence just as they are seen as you turn your fire-finder from Azimuth 0 to 360 degrees; the other is to group them separately -- first the orientation points, then all the legitimate smokes, and then all the key points.

LOCATING AND IDENTIFYING SMOKES

HOW TO LOOK FOR SMOKE

Best results, in searching for smoke, can be obtained from a combination of general and intensive observations.

General observations are intended to be a look at your entire country instead of a constant staring at any particular point. Knowledge of your country will enable you to pick out instantly anything unusual as you make your general scanning.

General observations are made continuously during daylight hours in the following manner:

1. Make a systematic slow scanning of your entire seen area.
2. Do not actually focus your eyes on any particular point unless attracted by something unusual.
3. Spend more time in scanning areas of high risks such as logging operations, camping areas, fishing streams, and well traveled roads.

4. Do not overlook or skip areas of low risk or little use.
5. Following lightning storms; thoroughly scan areas involved.

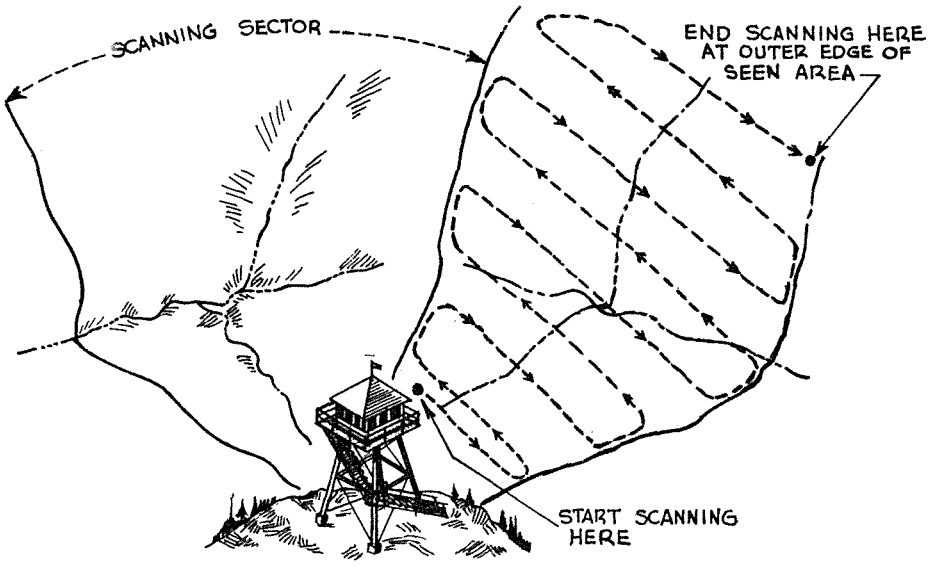


Fig. 97

Systematic Method of Searching for Smoke

Intensive observations are made at 15-minute intervals during daylight hours in the following manner:

1. Divide your entire seen area into units or sectors with readily recognized boundaries. This may be done by using ridges and drainages as boundary markers or by using the firefinder to form sectors of about 45 degrees (45^{o}) each.

2. These sectors must be small enough to allow thorough examination without too much shifting of the eye.

3. Start your intensive search in the same place each time and progress in a clockwise direction until all units have been examined.

4. In each sector start by examining the country nearest you first and progress outward to the limits of your seen area.

5. Make an intensive part-by-part examination of each sector.

6. Focus your eyes on those particular points of high hazard, within the sector, which you have determined are areas of heavy use.

7. Depending on the size and character of your seen area, the intensive check can be made effectively in from 4 to 6 minutes.

Colored glasses may be used when necessary to relieve eye strain.

Good binoculars are an essential tool in making your observation. They will help you identify small or difficult smokes, false smokes, and legitimate smokes. Excessive use of binoculars may result in eye strain, so be careful.

Through constant practice you will acquire the habit of making these general and intensive observations while performing your housekeeping duties, working on a going fire, or in the presence of visitors.

Check with your Dispatcher before leaving your station for even short periods of time.

HOW TO IDENTIFY SMOKES

Your ability to identify rapidly and properly the smokes that you see will aid the Dispatcher in deciding the action to be taken.

You will have three types of smokes to deal with -- legitimate smokes, false smokes, and illegitimate smokes.

Whenever you are in doubt as to the identification of a smoke, report it at once to your Dispatcher.

Legitimate Smokes:

a. Are authorized by law or permit.
b. Are under control.
c. Come from sources such as locomotives, sawmills, ranches, debris burning, industrial operations, or campfires.
d. Should be currently recorded on your form, "Orientation Point, Legitimate Smokes and Key Points".
e. Have a definite pattern as to the time of day they appear, volume of smoke, color of smoke, length of time visible.

Any change from this pattern that you observe should be reported to your Dispatcher on the chance that the legitimate fire may have escaped control.

False Smokes:

a. Are anything that might be mistaken for smoke under certain light and weather conditions.
b. Common things reported as false smokes are:
   Distant rock slides
   Openings in timber or brush
   Small areas of dead timber
   Dust from vehicles or livestock
   Fog or cloud puffs
c. Permanently fixed false smokes, such as rock slides or dead timber, should be recorded on your form, "Orientation Point, Legitimate Smokes and Key Points".

When in doubt about a possible false smoke, report it as a fire.

Illegitimate Smokes:

a. Any smokes not authorized by law or permit.
b. Any fires out of control.

All illegitimate smokes should be reported at once to your Dispatcher.

HOW TO DESCRIBE SMOKE

Volume, Character, and Color of Smoke

Your description as to the volume, character, and color of the smoke seen will be an indication to the Dispatcher of the size, intensity of the fire, and the type of material burning.

Volume may be described in general terms as:

Small - amount of smoke from average campfire
Medium - amount of smoke from 10 campfires
Large - any smoke larger than above

The fact that the volume is increasing or decreasing is most important.

Character may be described as:

Thin - a smoke narrow in width and of light density
Heavy - smoke of greater density
Billowy - large volume of smoke rising vertically which may have a mushroom or thunderhead effect on top
Drift smoke - smoke that has followed air currents and gives a long strung-out effect
Blanket smoke - layer of smoke over large area

Color of smoke indicates the type of material burning such as:

White smoke - generally grass, herbs
Grey smoke - light brush, sage, buckwheat
Black smoke - heavy brush, oak, manzanita, pitchy logs
Blue smoke - same as black smoke, less density
Yellow smoke - generally pine trees, herbs
Coppery smoke - light brush, sage, buckwheat

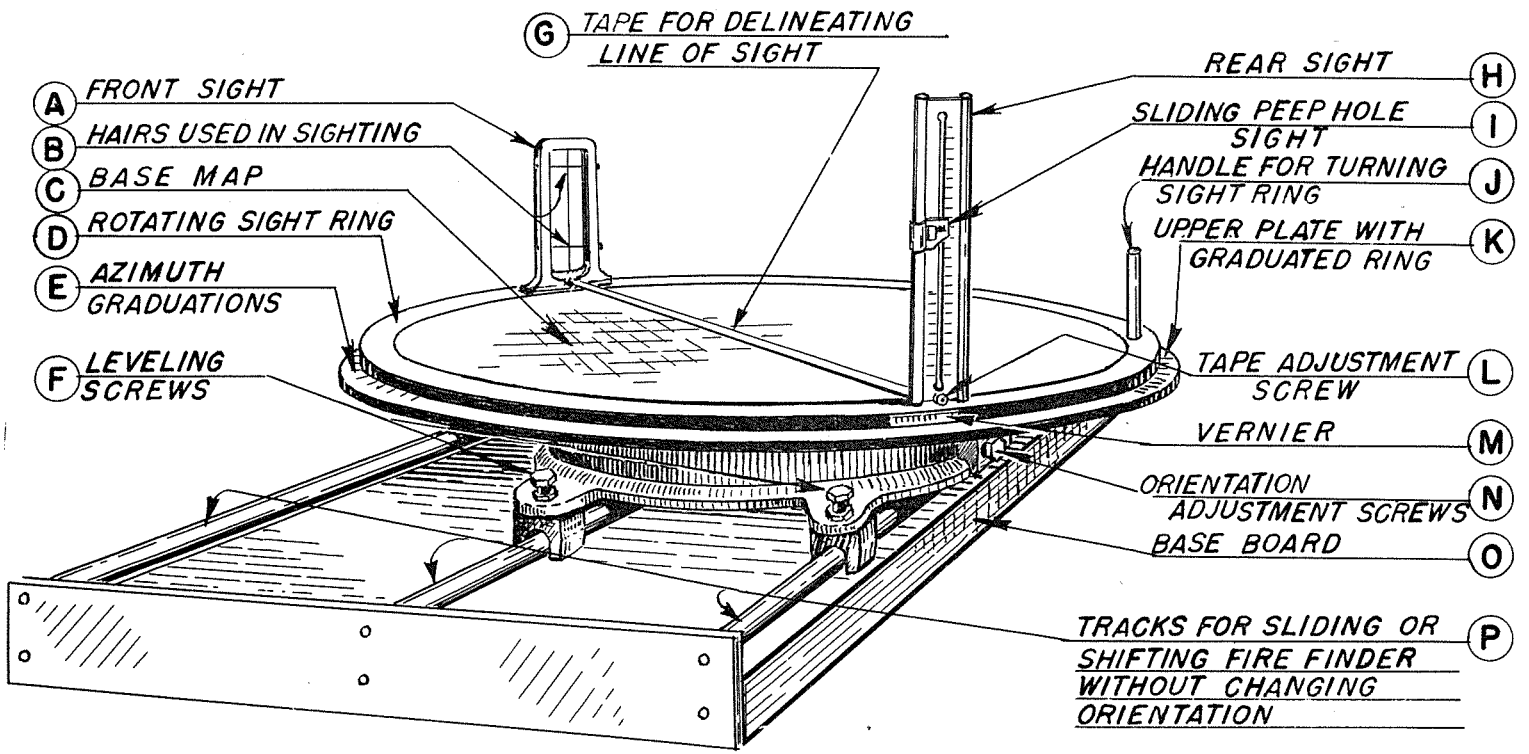

THE OSBORNE FIRE FINDER
A FRONT SIGHT
B HAIRS USED IN SIGHTING
C BASE MAP
D ROTATING SIGHT RING
E AZIMUTH GRADUATIONS
F LEVELING SCREWS
G TAPE FOR DELINEATING LINE OF SIGHT
H REAR SIGHT
I SLIDING PEEP HOLE SIGHT
J HANDLE FOR TURNING SIGHT RING
K UPPER PLATE WITH GRADUATED RING
L TAPE ADJUSTMENT SCREW
M VERNIER
N ORIENTATION ADJUSTMENT SCREWS
O BASE BOARD
P TRACKS FOR SLIDING OR SHIFTING FIRE FINDER WITHOUT CHANGING ORIENTATION

Fig. 98
The Osborne Firefinder

USE OF THE OSBORNE FIREFINDER

The Osborne Firefinder is the basic tool of your job. It is used to accurately locate fires or smokes which you will discover. The accuracy of your reports of fires will depend, to a large extent, on how well you keep the instrument adjusted and oriented. Knowledge of the various parts of your firefinder (see Fig.98.) will enable you to keep it in adjustment.

HOW TO ADJUST AND ORIENT THE FIREFINDER

1. Leveling Your Firefinder

Each morning check to see that your firefinder is level in in the following manner:

a. Place level tube on machined surface of graduated rim (Fig.99.) at about 45 degrees (45°) azimuth.
b. If the bubble in the level tube is not level, turn leveling screws until bubble in level tube is exactly centered. (See Fig.99.)
c. Then place the level on the graduated rim at approximately 135°, next at 225°, and last at 315°. If not level, adjust leveling screws at each setting.
d. Keep guide lugs on the base of the firefinder below the center line of track to prevent side play. WHY: To prevent errors in horizontal readings. The slightest side play will make horizontal angle readings incorrect. (See Fig.99.)
e. If you have trouble leveling the finder in more than one position, contact your Ranger for proper instructions.

The firefinder must be level before any further adjustments can be made.

Fig. 99
Leveling the Firefinder

2. Checking Sights And Vertical Hair For Plumb

a. Firefinder has been leveled.

b. Check vertical hair in front sight by following steps:

(1) Hang weighted thread or string from nail inside window frame.
(2) If vertical hair does not coincide with string, hair is not straight.

c. Adjustment

(1) Loosen screw on sight fastening the horsehair.
(2) Pull the horsehair tight.
(3) Tighten the screw again.
(4) Hair is then tight and straight. If it does not coincide with string, notify Ranger.

d. Replacing Vertical Hair

(1) Have on hand extra supply of dark horsehair. (In emergency black thread or fine wire may be used temporarily.)
(2) Loosen both top and bottom screws holding hair.
(3) Thread new hair through bottom holes in sight standard.
(4) Wrap hair around bottom screw and tighten screw.
(5) Thread hair through top hole.
(6) Pull tight.
(7) Wrap around top screw and tighten screw.

e. Checking Rear Sight Slot To See If Vertical

(1) Finder has been leveled.
(2) Hair on front sight is plumb.
(3) Look through rear sight at small dot or point on the wall.
(4) Raise eye slowly from bottom to top of slot.
(5) If dot is visible from bottom to top, rear sight is vertical.
(6) Report to Ranger if slot is not vertical.

3. Orienting Firefinder

This should be done daily. Firefinder has been leveled, cross hairs are plumb. A designated orientation point has been selected by the Ranger and the bearing recorded and posted in the lookout house. If this point does not check, the firefinder must be oriented in the following manner:

a. Loosen orientation adjustment screws below the upper plate of firefinder. (See N, Fig. 98.)
b. Set vernier at correct reading of orientation point.
c. Revolve, not the sights, but the entire plate of the instrument until sights are trained on orientation point.
d. Tighten screws below plate of finder.
e. Finder is then oriented.

4. Orienting Map Disk

This should be done daily. Finder has been leveled and oriented.

a. Set vernier at correct reading for designated orientation point selected by the Ranger. Locate this orientation point on your firefinder map. If the steel tape does not pass directly over the orientation point on your map, the disk is not oriented. Then follow these steps:

b. Loosen flat head screws around outer edge of map.

c. Revolve the map disk until the orientation point shown on the map lies directly under the steel tape.

d. Clamp disk in place by gently tightening the flat head screws being careful that the position of the disk is not disturbed in the process.

e. Repeat operation using a second and third orientation point to recheck your work.

f. Notify your Ranger if your map cannot be oriented within 15' (minutes) on at least three orientation points.

5. Adjusting Distance Tape

a. Distance tape is suspended between front and rear sights by adjusting screws.

b. Adjust screws at either end of tape so that "0" point on the tape will be directly over the center pin. (See Tape G, Fig. 98.)

c. Be careful -- too much tension on the tape will spring the sight ring and cause it to turn hard.

CARE OF THE FIREFINDER

1. Keep your firefinder clean. Use solvent if sticky or rusty and a powdered cleanser for general cleaning. Polish all brass parts.

2. The firefinder is not intended to be a table. Don't use it as a place to set cups, ashtrays, binoculars, clothing, or books. Use the shelves of your firefinder stand for storing the items you need to do your job, such as binoculars, instruction booklets, pencils, diary and log book, records and first aid kit. Keep the items on the shelves arranged neatly.

3. Keep a thin coat of light oil or graphite on tracks and sight ring to prevent wear and rust.

4. Map should be kept clean and in good condition. If a new map is needed, notify your Ranger.

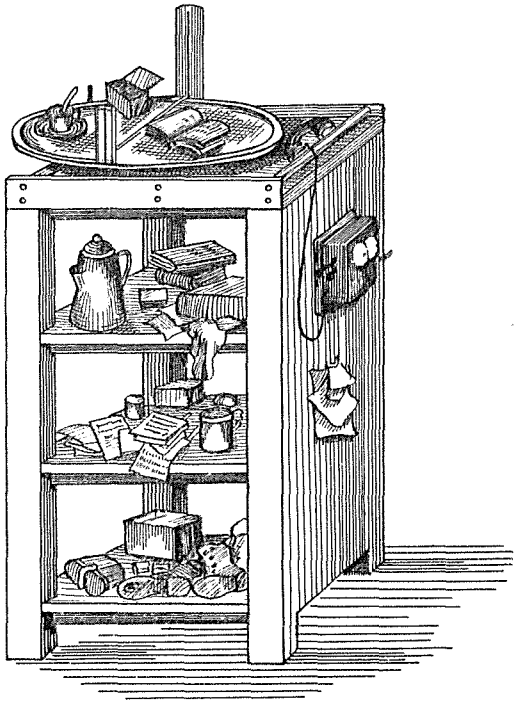


Fig. 100
Improper Use

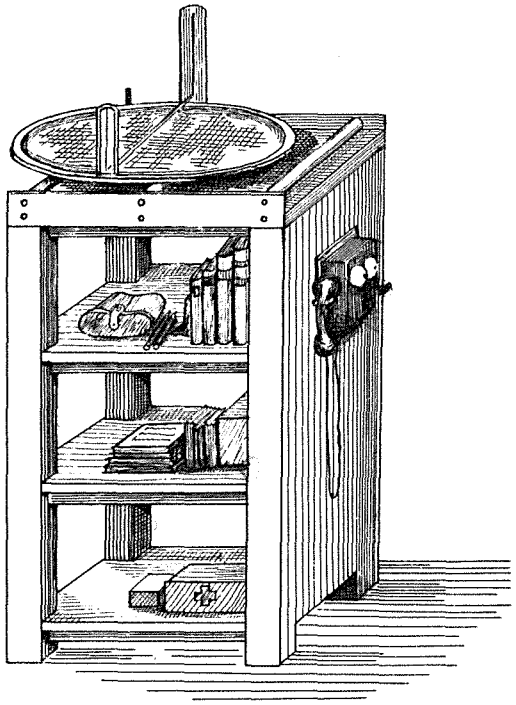


Fig. 101
Ready for Use

5. Before you close your station protect the Finder as follows:

   a. Clean thoroughly.
   b. Coat all metal parts with mineral oil.
   c. Release tension on cross hairs and distance tape.
   d. Remove map and store in dry place or send it to headquarters as directed.

HOW TO USE THE OSBORNE FIREFINDER

The Osborne Firefinder measures angles similar to compass readings to smokes. These angles are known as "horizontal angles" and "vertical angles". The horizontal angle is called the "Azimuth" and is measured from the north in a clockwise direction. The azimuth circle is graduated into 360 degrees with true north indicated by "0". The horizontal angle, or azimuth, is more important than the vertical angle in cases where two or more lookouts see the fire. Vertical angle readings are helpful where only one lookout can see the fire. Azimuths are read from the graduated azimuth rim around the firefinder, and vertical angles are read from the scale on the rear sight.

You will notice that the azimuth circle, or the rim around the outside of the finder plate, is marked with degrees and fractions of degrees. "0" (zero) on this rim, when the firefinder is properly oriented, is on the south side of the rim. This has been done for convenience in reading the azimuth. If the figures were placed in their true position, you would have to go around the finder to the opposite side in order to take the reading, thereby consuming valuable time. Figure 98 pictures the Osborne Firefinder, illustrating the different parts referred to in the following paragraphs.

The Proper Procedure In Using The Firefinder Is As Follows:

When a fire is "spotted", turn the sighting ring (D) by use of handle (J). Your eye should be within two (2) inches of rear sight (H). Line up the vertical hair of front sight (A) and the slot in back sight (H) so that vertical hair appears

in the center of the fire. Readings can now be made. (Slide firefinder on tracks or move to other set of tracks to give clear line of sight around obstructions such as corners of buildings, stove pipe, or window frame.)

How To Read A Horizontal Angle Or Azimuth

To see how to make the proper azimuth readings, refer to Figure 102. The vernier plate is attached to the movable sighting ring and is used to read the azimuth, not only in degrees, but in fractions of degrees. A degree is divided into smaller divisions known as minutes. There are 60 minutes in a degree. The symbol for degree is ^{o}. 21 degrees and 30 minutes is abbreviated 21^{o} and 30'. Looking at the Azimuth Graduation in Figure 102 you will find that "0" rests between 21^{o} 30' and 22^{o}. In order to find how many minutes past 21^{o} 30' the marker lies, run the eyes toward the left until you see a line on the Vernier coinciding with a line on the Azimuth Graduation. You will find that the line on the Vernier that does coincide with a line on Azimuth Graduation is "15". The vernier is graduated in minutes, so add 15 minutes to 21^{o} 30' and you will get 21^{o} 45'.

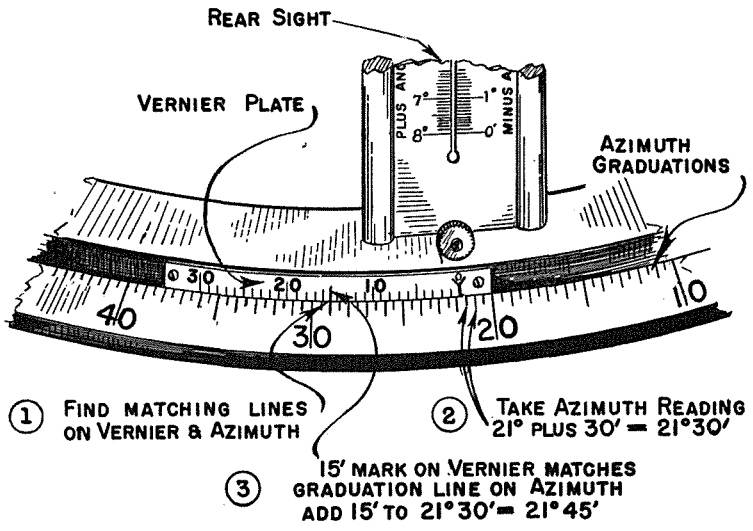


Fig. 102
Vernier Plate on Osborne Firefinder

With the present string maps used by the Dispatcher on a fire, reading to the nearest 1/2 degree is close enough for him to start action. You will want to use a finer reading for orienting your firefinder, studying the surrounding country, and measuring the size of fires.

You should try for accuracy and speed in taking your "shots" as time is precious where fire is concerned. By studying your country and using the orientation charts, you should become fairly proficient in the use of the firefinder.

How To Obtain A Vertical Angle Reading

The vertical angle is measured by the sliding metal piece on the rear sight. Figure 103 shows a close-up of the rear sight mechanism. There are two sets of figures marked on this sight; one reads "Plus angle read from top hair" and the other reads "Minus angle read from bottom hair".

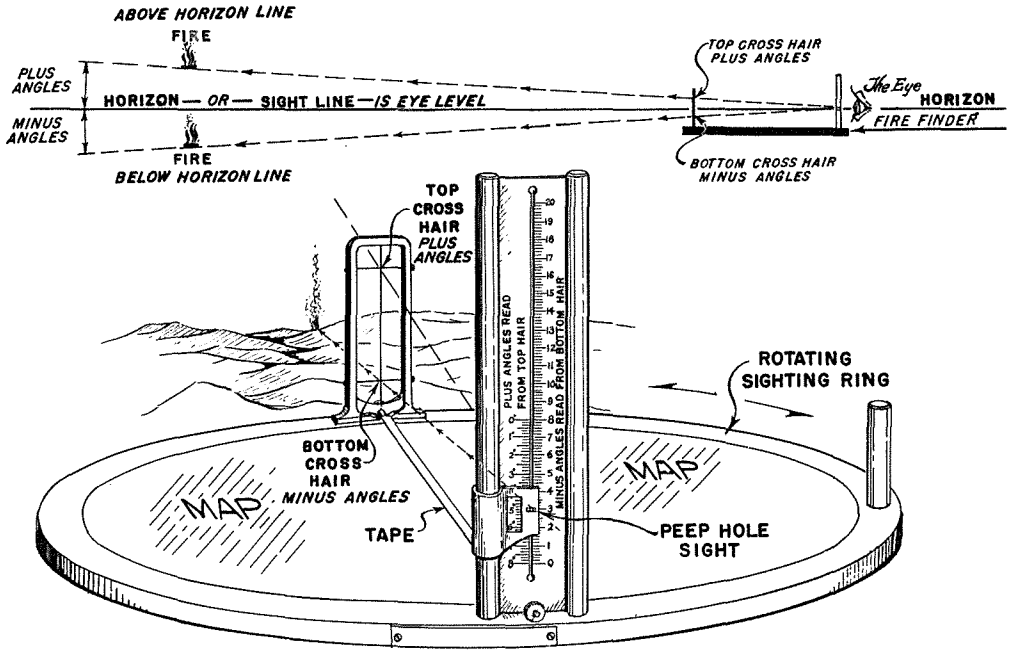


Fig. 103

How to Read Vertical Angle

Adjust the sliding peep-hole so that it rests on "0" at the bottom of the right hand or "minus" scale and look through the peep-hole. The bottom cross hair should appear in the center of the peep-hole. All objects sighted with the sight in this position are on the same level as the lookout point; subsequently, as you raise the peep-hole, other objects seen (using bottom cross hair) are below the elevation of the lookout.

To sight objects above the level of the lookout, the left hand or "Plus" scale and top cross hair are used. Sighting through the peep-hole with the marker at the upper "0", one can see that objects seen through the top cross hair are also on a level with the lookout; but as the peep-hole slides downward, objects seen are above the lookout level.

The vertical reading pictured in Figure 103 (using bottom hair scale) is -3^{o}. Each mark between numerals is 10 minutes. The minus figure (-) indicates that the origin of the fire is below the lookout level. Most of the readings will be a minus figure as fires generally start at the lower, more heavily used elevations below the lookout point.

How To Use The Metal Tape

The metal tape stretched across the center of the map on the Osborne Firefinder is used for estimating the distance of a fire from the lookout point. The first mark near the center of the tape should be directly over the pin in the center of the map. The scale on the tape is in inches, thus on a 1/2-inch scale map a fire estimated to be 3 inches from the tower (on the map) would be 6 miles from the tower (on the ground). Sometimes it is very necessary that the distance to a fire be given to the Dispatcher, as in the case where only one lookout man can see the fire. In the study of your country you should stress this phase of the job so that you can become proficient in this operation.

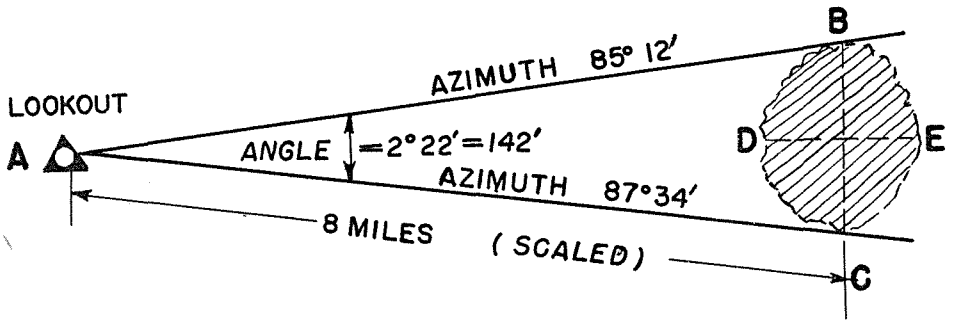


Fig. 104

How to Determine Size of Fire

A = Lookout Station

AC = Azimuth reading, right edge of fire 87° 34'

AB = Azimuth reading, left edge of fire 85° 12'

Difference between azimuth readings 2° 22'

2° 22' converted to minutes = 2° x 60 + 22' = 142'

AC = 8 miles (Scaled by metal tape on map)

Apply rule: Number of minutes x 1 1/2 x no. of miles

Insert values: 142' x 1 1/2 x 8 = 1,704 feet which is width of fire

Distance DE - estimated to be 800 feet

Area of fire = $\frac{1,700 \times 800}{43,560}$ = 31 + acres

Note: 43,560 is the number of square feet in an acre.

How To Determine The Size Of A Fire By Use Of Firefinder

You can determine the approximate size of a large fire, if you can see both sides of it.

1. Take accurate azimuth reading to each edge of fire. Use vernier to give reading in minutes.

2. Subtract to find the azimuth difference between readings, and then convert the difference to minutes. (1 degree = 60 minutes.)

3. Multiply the number of minutes by 1 1/2, and the result by the number of miles from the lookout to the fire.

4. The final result will be the distance in feet, between the two edges of the fire at right angles to your line of sight.

5. Estimate the other dimension of the fire, and size can be computed. Another lookout may see the other dimension and be able to compute its width for you. See Figure for sample problem.

HOW TO REPORT A FIRE

When you see what appears to be a smoke, you must decide whether it is a false or real smoke. If it is a real smoke, is it a legitimate or illegitimate fire? These decisions must be made quickly and accurately and an immediate report made if a fire is starting. If you have any doubts about your decisions or what you have observed, report to your Dispatcher immediately, giving him all the facts. Don't take any chances. We would rather answer some "false alarms" than miss prompt attack on a potential big fire.

"LOOKOUT REPORT"

The time when you decide to report the fire should be entered as "time sighted" on the "Lookout Report", Form 265-R5. Record the data for items 1 to 5 on Lookout Report. Report immediately to your Dispatcher the data for items 1 to 5.

Form No. 265-R5

LOOKOUT REPORT OF Slate Mountain (Name of Fire)

Always Report Items No. 1 thru 5

(1) STATION REPORTING Sligh Mtn. Lookout

(2) AZIMUTH 91° 30'

(3) BASE OF SMOKE SIGHTED Yes ✓ No ____

(4) VERTICAL ANGLE −1° 30'

(5) LOCATION BY LANDMARKS West slope of Slate Mountain near top.

Report Items No. 6 thru 11 as Requested

(6) WHAT IS BURNING Check best descriptive term:

Grass ____	Reproduction ____	Vehicle ____
Brush ____	Slash ____	Unknown ____
Timber ____	Building ____	Other ✓ (Specify)

Appears to be a single snag.

(7) APPEARANCE OF SMOKE Check best descriptive term:

VOLUME	COLOR	CHARACTER
Small ✓	White ✓	Thin ✓
Medium ____	Gray ____	Heavy ____
Large ____	Blue ____	Billowy ____
	Black ____	Drift Smoke ____
	Yellow ____	Blanket Smoke ____
	Coppery ____	(Other) increasing column.
	(Other) ____	(Such as puffs, column, increasing or decreasing)

(8) DIRECTION FROM WHICH SMOKE IS DRIFTING Calm

(9) DISTANCE TO FIRE 3 miles

(10) SIZE (Estimated) spot on single snag

(11) LOCATION OF FIRE T 25 N R 11 E Sec. 18

Always record

	DATE	TIME	
(12) ORIGIN	6/15/64	1402	Known ✓ Guess ____
(13) SIGHTED	"	1402	By Lawe
(14) REPORTED	"	1402	To Disp. Quick
			At Wright Creek R.S.

(Over)

Fig. 105

INSTRUCTIONS TO OBSERVER

1. Record in item 13 "time sighted".
2. Record and report items (1) through (5) to your Dispatcher.
3. Upon completion of initial report to Dispatcher, record "report time" in item (14).
4. Record items (6) through (10), but do not report them unless requested by Dispatcher.
5. Later Dispatcher will furnish "name of fire" and "time of origin," item (12), and actual "location", item (11).
6. Keep diary of subsequent action on this side of form (below) or in "Daily Log and Diary" as instructed.
7. Completed form should be carefully stored at your station.

SUBSEQUENT ACTION LOG

AGRICULTURE—FOREST SERVICE—SAN FRANCISCO

The Dispatcher will request other data as needed. Record items 6 to 11 after the first report.

Item (1) Station Reporting

The name of your lookout station. (A supply of report forms with this item filled in should be kept ready for immediate use on your firefinder stand. These forms should be carefully stored at your station when completed.)

Item (2) Azimuth

Record angle to nearest 1/2 degree. The azimuth or horizontal angle is the reading given by your firefinder. (See page 144 for "How to Obtain Horizontal Angle Reading".)

Item (3) Origin Of Smoke Sighted

Check YES if:

a. You can see actual starting point of fire.
b. Or you can see the smoke rising through the timber cover at origin of the fire.

Check NO if neither of above is true.

Item (4) Vertical Angle

Record to nearest 10' (ten minutes), which is the small graduation on vertical scale. (See page 145 for "How to Obtain Vertical Angle Reading".) Vertical angle reading will not be taken if "Origin of Smoke" cannot be seen.

Item (5) Location By Local Landmarks

Describe location of smoke by generally known landmarks. Use accepted local names. Example: "On small flat east side of Bear Creek, 1/2 mile below Red Bridge."

Report items 1 to 5 to Dispatcher and stop. This will clear telephone or radio circuit to start action if he desires to do so. Dispatcher will request additional information as needed.

Item (6) What Is Burning

Put check mark after the term best describing what you see or believe is burning. Write in your own terms after "Other", if not described above.

Item (7) Appearance Of Smoke

Check one best descriptive term under each heading of Volume, Color, Character. (See page 133 for "How to Identify Smoke".)

Item (8) Direction From Which Smoke Is Drifting

Enter one of the eight main points of the compass from which the wind is blowing at the fire. Examples: NE, E, SE, S. Wind direction is always recorded as the direction from which the wind is blowing, or from which the smoke is drifting.

Item (9) Distance To Fire

Report to nearest 1/2 mile the distance from your lookout to the fire. Use metal tape scale. (See page 146 for "How to Use the Metal Tape".)

Item (10) Size (Estimated)

a. Report in acres if more than one acre.
b. Report to nearest 1/4 acre if less than one acre. (See page 148 for "How to Measure Size of Fire With Firefinder".)

Item (11) Location Of Fire - Township, Range, Section

This is the map location by legal subdivisions. Enter your estimated location.

Time Blocks

(Time should be recorded in 24-hour clock time - see Appendix #2.)

Origin - Dispatcher will give you this data as time allows.

Sighted - Enter Date and Time you decided you had an illegitimate fire to report. Enter your name after "By_____".

Reported - Enter Date and Time you finish giving your initial fire report to the Dispatcher. Enter name and location of person to whom you gave your report.

NOTE:

After reporting a fire or smoke you should enter the following information in your "Daily Log and Diary".

Time reported
Azimuth and vertical angle
Name of person and station to whom you reported
After a fire has been identified by a name, you should enter the fire name in the Log also.

HOW TO USE DAILY LOG AND DIARY

The Daily Log and Diary is used by all Lookouts and some Ranger District Clerks and Dispatchers to record telephone and radio messages or other important messages, activities or happenings at their station. The time and the name of the person and station talked to should be recorded for all entries, as well as a brief of the message or incident being reported.

Lookouts should also record all smokes in the Log Book as well as on the individual "Lookout Report on Fires" form, Figure 105. Detailed instructions for use of the Log and Diary, as well as sample entries, are given in each Log Book.

DAILY LOG AND DIARY

Form 934
(Rev. Jan., 1933)

Forest Ponderosa
Name of station Kiffetan
Name of guard Ed Fitts
Date Aug. 19, 1954

WEATHER (Report other weather changes currently below)

Hour	Sky Conditions Rain Clouds	Temp.	Humidity	Wind Direction	Wind Velocity	Visibility	Precipitation at 5 P.M.
0900	Cloudy	60	55	SW	10	15	
1300	"	90	21	SE	15	12	.0
1700	"	70	45	SE	18	0	

Activity Index (Not to be used for all entries)	Hour	Min.	A.M. or P.M.	Bearing (If any)	Message to or From Whom (If any) Station	Person	Digest of Conversations and Observations (Use several lines and reverse side if necessary) (Always show clearly if message was TO or FROM you)
	07	00	a.m.		Sinsaville	Doe	I called and reported in. Ranger Smith is to be at Lupe Mtn. this a.m.
	09	05	"				Took weather observations
	09	21	"	SW			Lightning storm passed - (See details on my Lightning Strike Record for today.)
French Cr. Fire	10	02	"	123			Discovered by me.
" " "	10	06		123	Sinsaville	Doe	I reported the fire and told Doe it was in N branch of French Creek. Burning slow. A 1-man fire. Doe told me Fireman Jones from Frenchtown will be sent at once.
" " "	11	18	"	128	"	"	I called and reported that smoke was almost invisible. Fire apparently O.K.
	12	00					Noon check call.
	13	00	p.m.				Took weather observations
False Alarms	14	03	"	110			I called and reported suspicious looking haze in Tom Bulch, but it did not look like smoke. Doe said he would call John Mtn. L.O. for cross reading.
	14	05	"	110			Doe Telephoned me that this haze was slop dust.
	15	05	"				Supervisor Bayles arrived for the night

Fig. 106

WHAT TO DO WHEN LIGHTNING STORMS OCCUR

1. When lightning is seen or thunder is heard within 30 miles of your tower, make the following report to your Dispatcher:

   a. Name of your station
   b. Intensity of storm:

      (1) MILD: Consists of 2 or 3 thunder claps and only cloud lightning.
      (2) MODERATE: Produces sharp thunder claps with several lightning strikes to the ground in addition to much cloud to cloud activity.
      (3) SEVERE: Accompanied by almost continuous thunder and cloud to cloud lightning with many ground strikes.

2. Watch continually for strikes.
3. Keep a record of location of all strikes to ground. This may be done by three methods:

   a. Record data on lightning strike record "Form 83R-5".
   b. Record in Log.
   c. Mark location on firefinder by using a red grease or china marking pencil.

4. When lightning storm is near or overhead, observe following safety rules:

   a. Stand on insulated glass-legged stool.
   b. Do not use telephone. Use rope to throw phone line switch.
   c. Do not use radio. Your Letter of Instruction in the front of this handbook will advise on disconnecting antenna.
   d. Keep doors and windows closed. Lightning follows air currents.

Form 83-R. 5

LIGHTNING STRIKE RECORD

On June 15 1954

High Mountain Lookout Ponderosa National Forest General Area Granite Basin
(As So. Slope Black Fox; Lyell Mt.)

Time of Strikes	Azimuth Reading	Vertical Angle	Miles Distant	Fire is located with respect to			It is			Can he see it direct	Is it over intervening ridge	It is burning				Smoke appearance			
				Direction	Distance	Named Landmark	A Spot	Small	Large	Yes / No	Yes / No	Single Snag	On Ground	In Brush	Where	White	Black	Thin	Other
1402	91° 30'	-1° 30'	3	West Slope	near Top	Slate Mtn.	✓			Yes ✓ / No	Yes / No ✓	✓				✓			
1403	98° 00'	-1° 00'	3	North End	Just over top	Slate Mtn.	✓			Yes / No ✓	Yes ✓ / No					✓		✓	
1403	97° 30'									Yes / No	Yes / No								
1405	91° 00'									Yes / No	Yes / No								
1407	87° 30'									Yes / No	Yes / No								
1410	103° 30'									Yes / No	Yes / No								
1410	78° 00'									Yes / No	Yes / No								
1411	72° 30'									Yes / No	Yes / No								
1411	70° 00'									Yes / No	Yes / No								
1412	65° 30'	-3° 30'	6	North	½ Mi	Rock Creek Camp	✓			Yes ✓ / No	Yes / No ✓			✓			✓		
1415	71° 30'									Yes / No	Yes / No								
										Yes / No	Yes / No								
										Yes / No	Yes / No								
										Yes / No	Yes / No								
										Yes / No	Yes / No								
Col. (1)	2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)

Fig. 107

Total No. of Strikes 11

Signature Hugh R. Lawe

e. Put out fires in stoves when severe storms are approaching.
f. Stay inside the protected house.

5. When the storm has passed, reestablish communications by telephone or radio with your Dispatcher or Ranger Headquarters.

6. Use the information regarding location of strikes gathered during the storm to try to discover smokes at these locations after the storm.

7. Watch the area of all strikes intensively for a period of at least five days after the storm.

LOOKOUT SAFETY HINTS

1. Use a flashlight when going up or down stairs at night.
2. Keep inside trap door to stairs closed except when stairs are in use.
3. Keep catwalk trap doors closed except during heavy visiting periods. When catwalk trap doors are open, be sure the bar at the open end of stairwell is in safety position.
4. Warn visitors of the danger of falls and see that children are not allowed unattended on catwalk.
5. Keep catwalks and stairs free of chairs, boxes, tools, and any other objects.
6. You will be supplied a copy of the Forest Service Safety Code. It is your responsibility to study this Code and do your job safely.

PUBLIC CONTACTS AND USE OF NATIONAL FOREST TRAVELERS' REGISTER

Visitors to your Lookout Station should be asked to register on the "National Forest Travelers' Register", Form 449a, or on some other suitable form provided for you by your Ranger. This registration is valuable to you as it gives you an opportunity to introduce the subject of fire prevention to your visitor. It also gives you a record of the names and addresses of some of the forest users in your locality.

MAINTAINING YOUR STATION

Your Lookout Station serves the dual purpose of your home and your place of work. The following steps will insure safety and good housekeeping. (Also refer to "Housekeeping" in Preparedness Chapter, page 58.)

1. Keep all windows clean and free of obstruction.
2. Store your fuel in a neat, safe manner.
3. Have floors clean and waxed at all times.
4. Determine the prescribed manner for disposal of garbage and use this method.
5. Keep refuse from accumulating in or around buildings.
6. Keep toilets clean and free of flys and rodents.
7. Provide a place for everything and keep everything in its place.
8. Complete the Fireman's Weekly Inspection Form. (See "Housekeeping" in Preparedness Chapter, page 58.)

CLOSING YOUR STATION

See "Guide For Closing Fireman Station" in Chapter on Preparedness, page 79. Also refer to paragraph on Care of Firefinder earlier in this chapter, page 141.

MAKING WEATHER OBSERVATIONS

Your Lookout may be one of those selected as a Fire Danger Rating or a Key Fire Weather Station. In this event, you will be supplied with additional training books and specific instructions on how to make these special observations.

LOOKOUT PROBLEMS

PROBLEM 1: INITIAL FIRE REPORT BY LOOKOUT

Condition

A lookout at Rocky Butte glances up while getting dinner to make a general observation of his country. His eyes are attracted immediately to a small smoke rising over a ridge where he knows there are no legitimate smokes.

Action Required

Lookout steps to firefinder and trains his sights on the center of the small smoke. He reads the azimuth to the closest 1/2 degree and enters it on his Lookout Report Form which is ready in place on a clip board hanging on his firefinder stand. He cannot see the origin of the smoke so can take no vertical angle shot. He knows the smoke is behind Granite Ridge. He enters item 13 - time sighted and then items 1 to 5 on the Lookout Report Form, calls his Dispatcher on the radio immediately and reports: "One, - Rocky Butte, Two, - 87 1/2, - Three, - No, Four, - None, Five, West side Granite Ridge." Dispatcher acknowledges and gives report time as "1214". This is 12:14 P.M. recorded in 24-hour clock time (see Appendix #2). Lookout enters this time as "reported" time and enters name and location of Dispatcher on Lookout Report. He completes additional data for items 6 to 11 on Lookout Report. He also enters the required information in his Daily Log and Diary.

Why

Housekeeping work did not interfere with general observations. He picked up the smoke quickly because it was unusual and out of place. Immediate, accurate reporting to Dispatcher insures prompt initial attack. Written report data insure good records.

PROBLEM 2: COMMUNICATION FAILURE

Condition

Lookout sights illegitimate smoke. He locates smoke with firefinder and makes proper entries on Lookout Report. He first tries to report the smoke by radio, but cannot reach any station. He next tries to telephone the Dispatcher, but cannot reach his office by phone.

Action Required

1. He uses telephone and calls nearest Fireman station to his lookout.

2. He makes his smoke report to fireman at this station. Fireman then can relay report by radio from his station or take some other action to get report to Dispatcher.

3. Lookout then checks all external connections on his radio. After some delay he finds loose battery connection which he repairs. He then makes radio contact with Dispatcher and gives him second report on fire; also reports telephone trouble.

Why

It is most important to get the smoke report to someone on the ground who can take action. Do this first if possible, then check equipment for trouble. The second report to Dispatcher will confirm the relayed message.

PROBLEM 3: LIGHTNING STORM

Condition

A general lightning storm develops during the night and moves in during the morning, arriving over a lookout at noon.

Action Required

Lookout reports the general condition to his Dispatcher as soon as observed in the morning. He reports lightning seen at 20 miles at 1030. He records lightning strikes observed, by azimuth and local landmarks. At 1205 he reports storm one mile distant, pulls his telephone disconnect switch, and disconnects radio antenna as instructed. (Refer to Safety Code Section 933.) He stays in building, away from metal objects, and does not use radio while storm is in progress overhead.

When storm has passed, he activates and tests his telephone line and radio by check call to Dispatcher. He gives special care in observing the areas of lightning strikes for several days. On the 4th day he picks up a small smoke from a sleeper fire and reports it to his Dispatcher.

Why

Lookout keeps Dispatcher informed of storm approaching and its progress. Conforms to all safety procedures required during lightning storms. From record of "strikes" is able to give special attention to danger areas and can pick up a sleeper fire before it becomes large.

PROBLEM 4: PUBLIC CONTACTS - VISITORS AT LOOKOUT STATION

Condition

A man and woman visit a Lookout Station. They are interested in the view, forest problems, and operation of the lookout, and stay for about an hour.

Action Required

Lookout welcomes them and points out scenic points. Lookout makes an intensive observation while visitors look around. He then gives them information on his job and forest protection in general. Has them sign National Forests Travelers' Register. Makes his regular intensive observations at approximately 15-minute intervals during their visit and carries on general observation while talking with them. He cautions visitors as to safety on the catwalk and makes sure stairway trap door is closed while visitors are on tour.

Why

Promote friendly relations with visitors and secure their cooperation in fire prevention and control. Cannot allow visitors to interfere with intensive or general observations. Records visitors' names in case of fire violations enroute to or from the Lookout Station.

Supplemental Action

Lookout should give visitors a map or prevention material to take with them to read.

REVIEW QUESTIONS -- LOOKOUT DUTIES

INTRODUCTION

1. What is your most important job as a Lookout?

ESSENTIAL QUALIFICATIONS OF YOUR JOB

1. What are two essential qualifications of a good forest lookout?

LEARNING YOUR COUNTRY

1. Why is it essential that you know the location and names of topographic features that you see?

2. Name three methods that will assist you in learning your country.

3. How can your firefinder be used to help you learn the country?

4. What is an orientation point? A key point?

5. Why should you keep a record of orientation and key points?

HOW TO LOOK FOR SMOKE

1. Describe the difference between a general and intensive observation.

2. How often should you make a general observation?

3. How long should it take you to make an effective, intensive observation?

4. How do you set up sectors for this intensive observation?

5. Should intensive observations be made in a clockwise direction?

6. How will binoculars help you in making observations?

HOW TO IDENTIFY SMOKES

1. Name the three types of smokes that you will have to identify.

2. What identifies a legitimate smoke?

3. If in doubt as to identity of smoke, what should you do?

4. Name 3 things that give the appearance of smoke under certain light and weather conditions.

5. Describe a smoke that is medium volume.

6. Describe drift smoke.

7. Does the color of smoke have any importance in reporting? Why?

HOW TO ADJUST AND ORIENT THE FIREFINDER

1. Name the four azimuth readings used in leveling the finder.

2. How often should your finder be checked for level?

3. What point should be watched for regarding the guide lugs?

4. How do you replace the vertical cross hair?

5. In orienting the finder, do you revolve the sights or the entire plate?

6. Why must the orientation point, used in orienting your finder map, be a point on the map?

7. What point on the distance tape should be directly over center pin?

8. Name the items that should be kept on the top of your finder at all times.

HOW TO USE THE OSBORNE FIREFINDER

1. What angles are measured by the firefinder?

2. These angles are measured in what units? Miles, feet, or degrees?

3. How can we make accurate reading to minutes?

4. Explain what is meant by azimuth.

5. Where do you read the vertical angle scale?

6. What is meant by minus (-) angle? A plus (+) angle?

7. How do you measure distances from your lookout to points on your map?

8. What is meant by a 1/2-inch scale map?

9. How can you determine size or dimensions of fires with the firefinder?

HOW TO REPORT A FIRE

1. You are not sure that what you see is a smoke or dust. What will you do?

2. To whom do you report fires?

3. The wind is blowing from east to west. What is the wind direction?

4. Why should you know and use local names of places and locations in your country?

5. You see a single snag burning. How will you report this under item (6) on Lookout Report?

WHAT TO DO WHEN LIGHTNING STORMS OCCUR

1. As soon as you see lightning or hear thunder, what should you do?

2. Why should a record be kept of all ground strikes observed during the storm?

3. When do you stop using the telephone and radio?

4. What do you do in case of communication failure?

5. For what period of time should the storm area be intensively scanned?

LOOKOUT SAFETY HINTS

1. Name three safety precautions regarding the catwalk.

2. Why should you practice safety?

3. Where else can you look to find safety hints and rules?

MAINTAINING YOUR STATION

1. Why should you keep the Lookout Station clean and neat?

2. Have you determined the safe way to store your fuel?

3. Why should windows always be clean in a lookout?

4. What is the prescribed manner for garbage disposal at your station? Do you use this method?

5. Where should you look in this handbook for more information on station maintenance?

PUBLIC CONTACTS

1. Why should you always continue your intensive and general observations regardless of who is visiting your station?

2. Why should some form of a visitors' register be used at your station?

CHAPTER IV

FIRE BEHAVIOR
AND
FIRE DANGER RATING

AIR
FIRE
FUEL

FIRE BEHAVIOR AND FIRE DANGER RATING

FIRE BEHAVIOR

Successful firefighting is based upon the knowledge of why a fire burns and what makes it spread. An understanding of the fundamentals discussed below will help you to do a better job.

HOW A FIRE BURNS

When enough heat is applied to a fuel, the result is fire. Fire is simply a rapid chemical combination of fuel, heat, and oxygen in the air. Heat is necessary to begin the reaction. Once started, fire produces its own life-giving heat. Forest fires originate from such sources of heat as sparks and embers from cigarettes, trash fires, car, truck, and tractor exhausts, and lightning.

As you can see, fire cannot exist in the absence of heat, fuel, or air. The basic principle of fire suppression is to remove heat or fuel or air in the quickest and most effective manner. There is no other way!

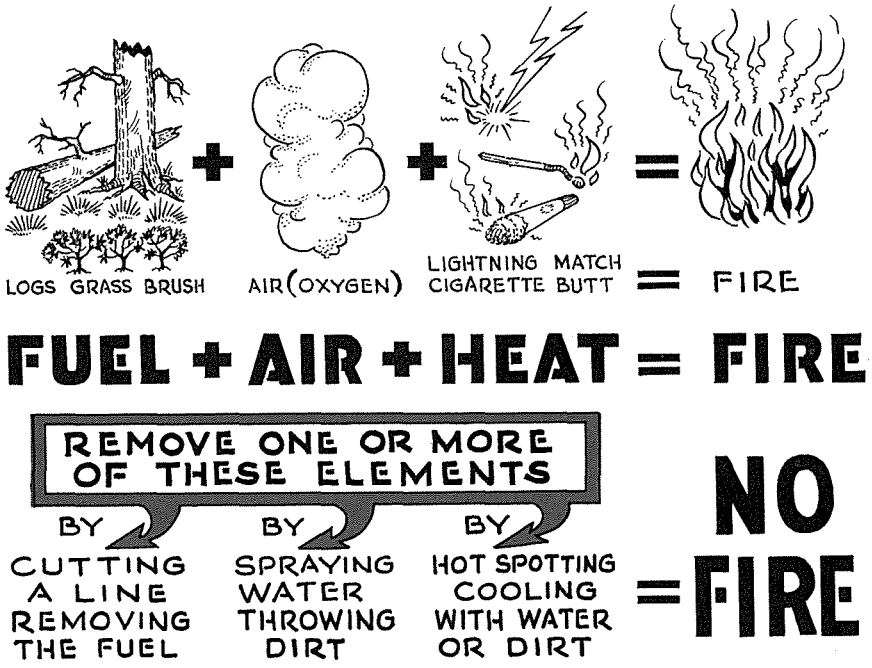

LOGS GRASS BRUSH
AIR (OXYGEN)
LIGHTNING MATCH CIGARETTE BUTT
= FIRE
FUEL + AIR + HEAT = FIRE
REMOVE ONE OR MORE OF THESE ELEMENTS
BY CUTTING A LINE REMOVING THE FUEL
BY SPRAYING WATER THROWING DIRT
BY HOT SPOTTING COOLING WITH WATER OR DIRT
NO = FIRE

Fig. 108

WHY A FIRE SPREADS

You can be effective as a firefighter if you know what makes a fire behave as it does.

Why does a fire burn fast? Why does it slow down? Why does it burn so intensely at times? Why does it burn in one direction and not another? Just what is the cause of this varying behavior?

There are many causes and reasons for fires acting as they do, but the primary factors that influence the spread of fire are: fuel, weather, and slope.

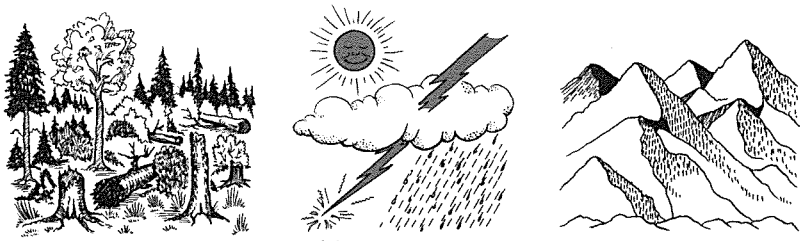


Fig. 109

Fuels

Fuels are commonly divided into two main groups:

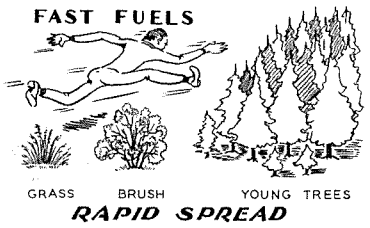


Fig. 110

1. Light or fast burning fuels make up one group -- dry grass, dead leaves and tree needles, brush, and small trees. Light fuels cause rapid spread of fire and serve as kindling for heavier fuels. Some green fuels such as tree needles, sage, chamise, ceanothus, and other brush types have a high oil content and are fast burning when they are not in the active growing stage.

2. Heavy or slow burning fuels are the second group -- stumps, branch wood, and deep duff. Duff is the top soil or partly decayed leaves and tree needles found under dense stands of brush or trees. Dry, heavy fuels burn readily and produce large amounts of heat.

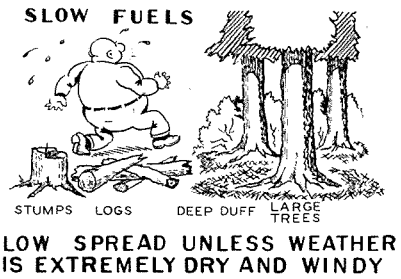


Fig. 111

Weather

Weather factors with which you as a firefighter will be concerned are: wind, moisture, and temperature.

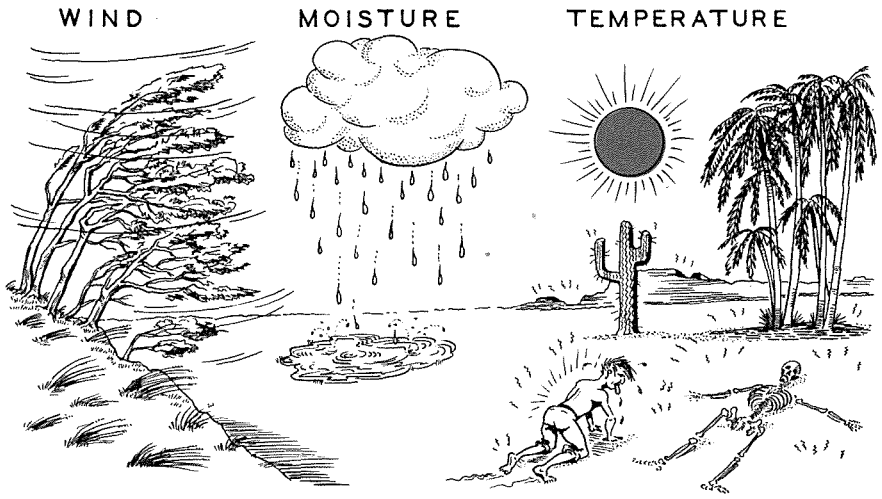


Fig. 112

1. Wind

The stronger the wind, the faster the spread of fire. This is true because wind brings an additional supply of oxygen to the fire, directs the heat (flame) toward the fuel ahead, and causes spot fires by blowing sparks and embers ahead of the main fire into new fuel.

Fig. 113

Fire itself causes local air currents that add to the effect of the prevailing wind on fire spread. The air above the flames becomes heated and rises. Then this fresh air rushes in and helps the burning. Generally, the wind is gentlest from 4 A.M. to 7 A.M. As heat from the sun warms the ground, the air next to the ground is heated and rises. So air currents usually flow up the canyons and slopes during the day. During the evening and night the ground cools and the air currents reverse their direction and flow down the canyons and slopes. The direction of canyon and slope wind flow should be remembered when planning the attack on a fire -- normally -- wind blows up the canyon by day and down at night.

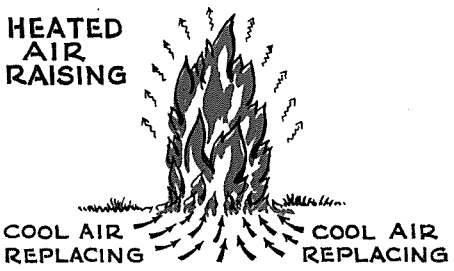


Fig. 114

2. Moisture

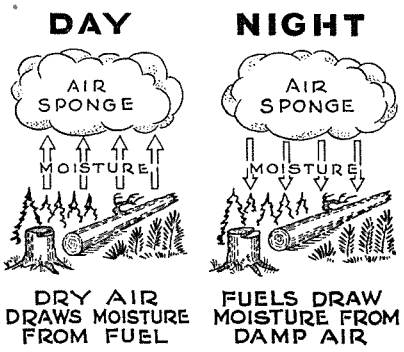


Fig. 115

Moisture in the form of water vapor is always present in the air. The amount of moisture that is in the air affects the amount that is in the fuel. Moisture is absorbed from wetter fuels by the air, and from the air by drier fuels. The moisture content of fuels is an important consideration in firefighting since wet fuels, and most green fuels, will not burn freely. Air is usually drier during the day than it is at night. Fires, then, burn more slowly at night, under normal circumstances, because moisture is absorbed by the fuels from the damper night air.

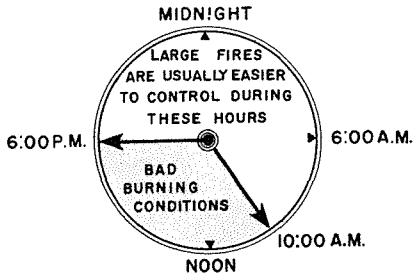


Fig. 116

Absorption of moisture by the fuels, down slope winds, lower temperatures, and other day-night weather differences generally aid the firefighter at night. This is why a fire may burn out of control in the afternoon and yet may be handled by the same crew at night. Every effort should be made to completely surround and permanently stop (to control) a fire before bad burning conditions build up the following day.

This does not mean that no attempt should be made to suppress fires during the day. Most fires are controlled during the day. If a fire cannot be controlled during the daytime, an all-out effort must be made at night.

3. Temperature

Air temperature affects firefighting. Fuels pre-heated by the sun burn more rapidly than do cold fuels. The temperature of the ground also affects the movement of air currents, as explained previously.

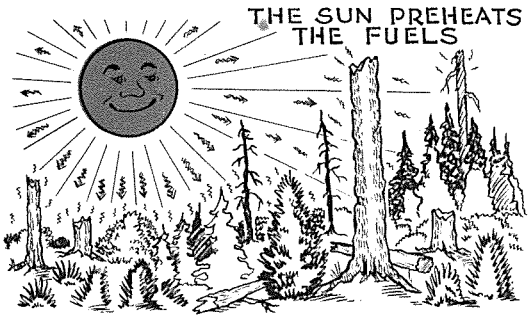


Fig. 117

Temperature also has a very direct affect upon the firefighters themselves, making it more uncomfortable and tiring to fight fires in excessive heat.

Slope

Slope greatly affects the spread of fire in two ways: by preheating and draft. A fire will run faster uphill than it will downhill if the wind is not strong enough to otherwise influence the spread. On the uphill side the flames are closer to the fuel. This causes preheating and faster ignition. Heat rises along the slope causing a draft which further increases the rate of spread.

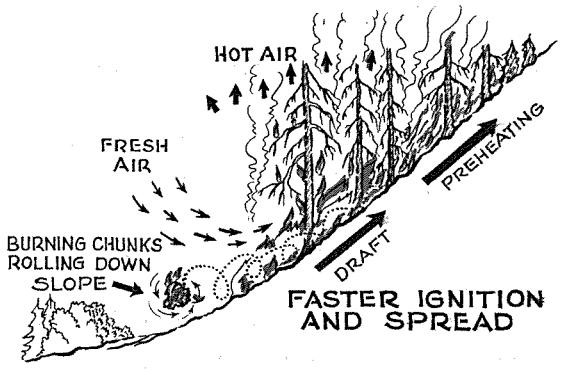


Fig. 118

On steep slopes burning chunks of fuel may roll downhill starting new fires.

REVIEW QUESTIONS -- FIRE BEHAVIOR

1. What three elements combine to make a fire burn?

2. What happens when one or more of the three elements are removed or reduced?

3. What are the three primary factors influencing the spread of fire?

4. How does wind effect the spread of fire?

5. During what period of the day are winds normally calm?

6. Why do fires normally burn slower at night than during the daytime?

7. What effect does air temperature have on burning?

8. How does slope effect the rate of spread of fire?

FIRE DANGER RATING

WHAT IS MEANT BY FIRE DANGER RATING

Fire Danger Rating is an important tool of the firefighter. It is a measure of the probability of fires starting and of the estimated burning intensity and rate of spread of fires which do start. Here in the California Region of the Forest Service, Fire Danger is expressed as a number or numerical index called the Fire Danger Index. It is derived from daily measurements of temperature, humidity, fuel, moisture, and wind. The higher the Index, the higher is the Fire Danger. To help plan fire-control work, the Index numbers are grouped into five Classes of Fire Danger: Low, Medium, High, Very High, and Extreme. Average Fire Danger is considered as being the midpoint between Medium and High.

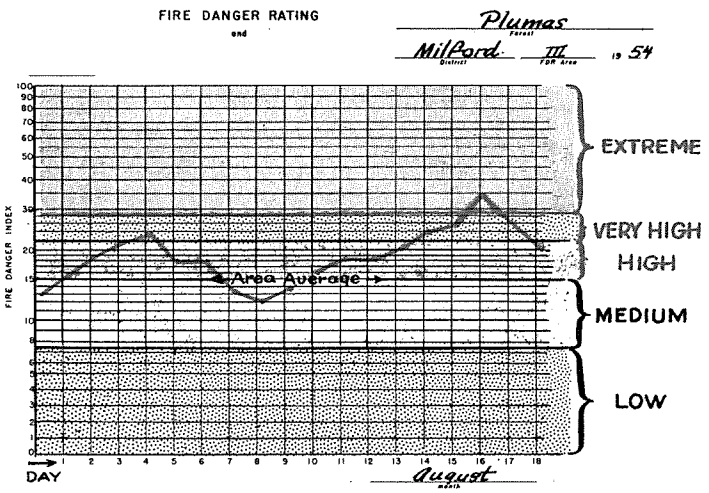


Fig. 119

FIRE DANGER RATING AREAS

All the National Forests in California are divided into areas, called Fire Danger Rating Areas, which have different weather, fuel, or topographic conditions. Because of these different conditions, the Class of Fire Danger on any particular day may not be the same from one Fire Danger Rating Area to another.

EXPECTED FIRE BEHAVIOR FOR EACH FIRE DANGER CLASS

Low

Fires do not start readily from most accidental causes, though many lightning fires may start in some areas during low danger periods. Fires which do start generally spread slowly, and there is little tendency for fires to spot. They often do not burn clean, but spread in irregular fingers.

Medium

Fires can start from most accidental causes, but the number of starts is generally low. Rate of spread of fires is moderate; heavy concentrations of fuel will burn hot, and there may be some spotting. Control of fires during medium danger periods usually presents no special problems.

High

Fires will start fairly easily from most causes. Fires will burn hot, spread rapidly, and will spot readily. Control of fires during high danger may become difficult, unless they are hit hard and fast while small.

Very High

Fires start easily from most causes. Fires will develop fast and can spread at high rates of speed with considerable spotting. Direct attack at the head of a fire is rarely possible after it has been burning a few minutes.

Extreme

Fires start easily from all causes and may be started by unusual or unexpected causes. Fires burn intensely and spread rapidly. Direct attack is rarely possible except when fires are still small. The running heads of large fires are usually uncontrollable while the extreme danger period lasts, and most effective control work must be confined to the flanks of the fires.

LIGHTNING FIRES AND FIRE DANGER RATING

No general rule can be made correlating the occurence of lightning fires with the Class of Fire Danger. In some areas many lightning fires may be started when the Danger is low, but lightning fires can start during any Danger Class. Although a fire might start during a storm when the Danger is temporarily in a lower class, the Danger may go right back up after the storm passes over, especially if the storm is "dry" or the rainfall is light. Lightning fires that do start will behave and spread as any other fire.

HOW FIRE DANGER RATING AFFECTS YOUR WORK SCHEDULES

Your work plans and days off are affected by the Fire Danger Rating of any day. Fire Prevention becomes especially important on days of High, Very High, and Extreme Fire Danger. You must intensify your efforts to prevent fires from starting on these days. If fires do start, quick attack is necessary, and you must work harder to catch these fires while they are still small.

The daily Fire Danger Rating and the weather forecast are used to predict tomorrow's Fire Danger. You may be ordered to work on your regular days off when Fire Danger is predicted to be High or above.

WHO MEASURES THE FIRE DANGER

Most of the weather observations used to determine the Fire Danger are obtained at stations selected throughout the national forests. If your station is selected to make weather observations, you should be careful in making your observations. Become familiar with the written instructions in the pamphlet, "Fire Danger Observations -- How to Make Them".

The observations which you will make, and those made by other stations will be compiled by your District Dispatcher or the Forest Dispatcher, who will compute the daily Fire Danger Index for your area.

CHAPTER V

STANDARDS OF LINE CONSTRUCTION

STANDARDS OF LINE CONSTRUCTION

When a line is stopped or controlled by creating a break in the fuel -- by cutting, scraping or digging -- such a break is called a fire line. A fire line must be wide enough to prevent the fire from smoldering, burning, or reaching across the line to ignite the fuels on the other side. Sometimes a fire line is simply spoken of as the line.

FUNDAMENTALS OF FIRE LINE CONSTRUCTION

The fundamentals of fire line construction are line width, line depth, line length, and overhead clearance above the line. Generally, the length of the line is more important than the width. Why? Because the line must encircle the entire fire to control it. The line needs to be only wide enough to keep the fire from crossing, but any gap in the widest line can let a fire escape. Constructing a line wider than necessary may result in not being able to encircle the fire. The effort spent in constructing the extra width could have been used to complete the line around the fire.

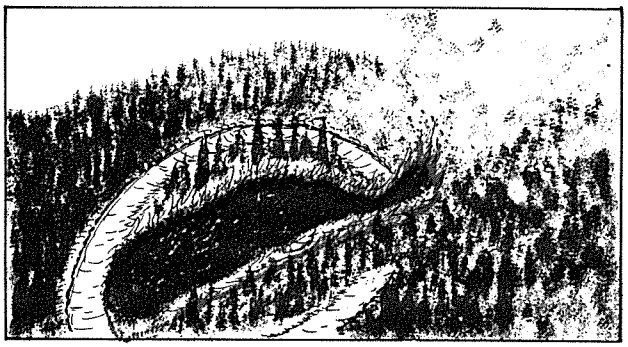
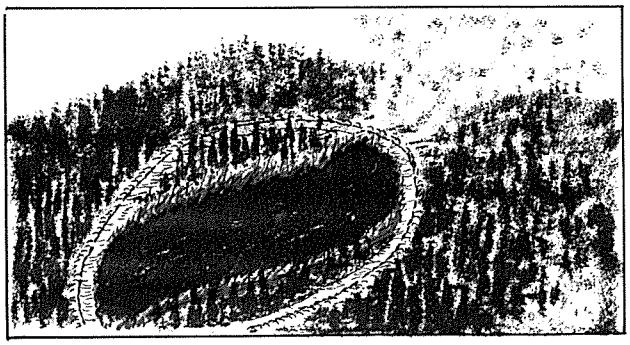


Fig. 120
Line Constructed Wider Than Necessary
(not wide enough to encircle fire)

Fig. 121
Line Constructed to Correct Width
(enough line to encircle fire)



HOW FIRES CAN CROSS THE FIRE LINE

Fire can cross a fire line in many ways.

1. Flames or heat reach across the line and ignite outside fuels. (This is important in determining width of line.)

Fig. 122

2. Sparks and embers cross the line.

   a. Sparks are blown across the line by the wind or are carried by air currents. (Usually not important in determining line width.)

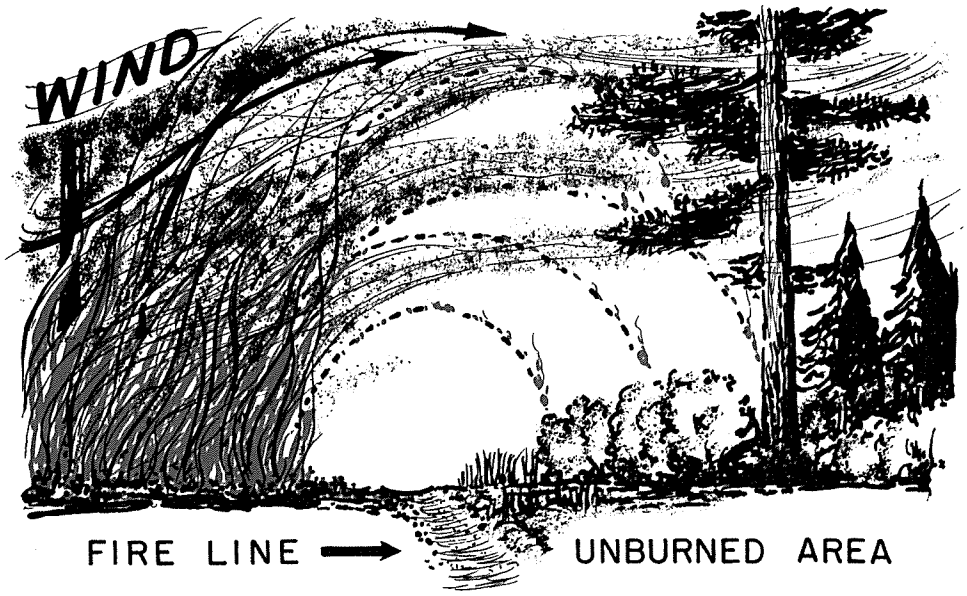


Fig. 123 Fire Line - Unburned Area

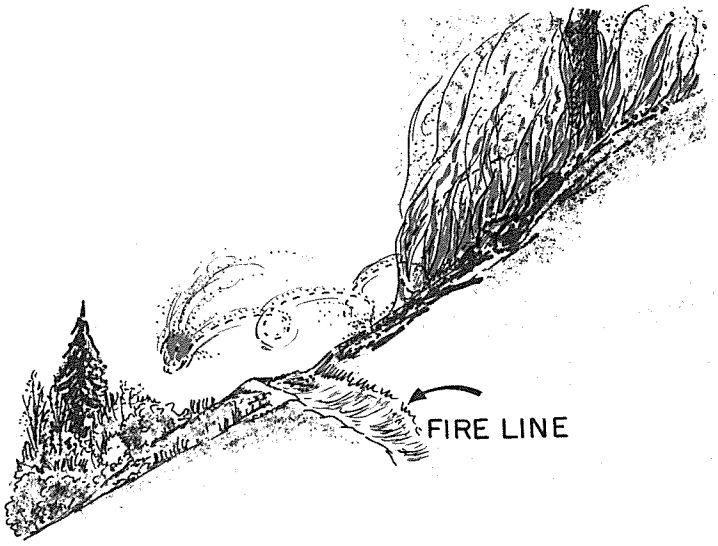


Fig. 124

b. Sparks are carried across the line by gravity -- rolling, sliding, or falling. (This is important in determining the depth of line and amount of trenching necessary.)

Fig. 125

c. Sparks or embers are thrown, dragged, or flipped across line by workmen, either carelessly or accidentally.

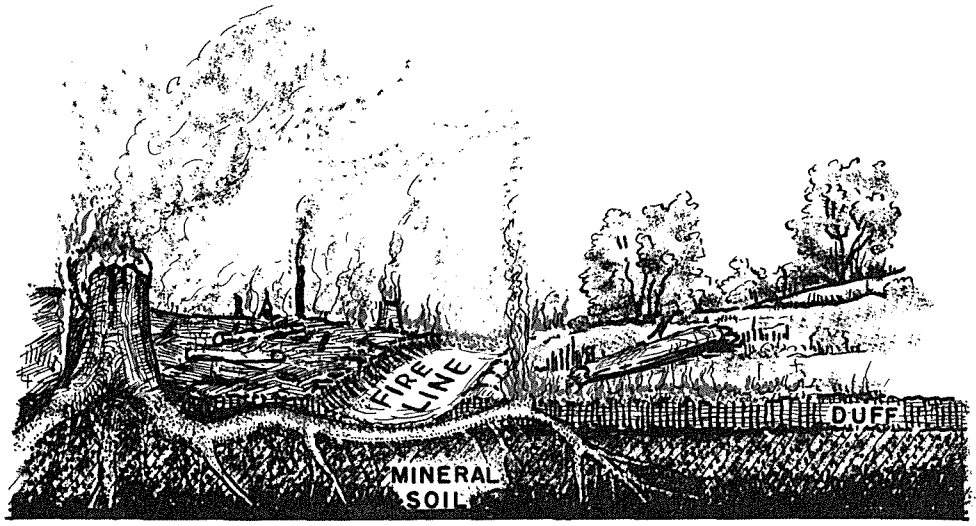


Fig. 126

3. Fire may creep across fire line through duff or roots. (Depth of line is important in preventing this.)

Fig. 127

4. Heat or flame may reach upward and ignite overhead fuels. (Overhead clearing above the line is important in preventing this.)

Heat can ignite fuels across or above the fire line even if flames do not reach the fuels. Radiation or convection of heat may ignite fuels on the opposite side of a fire line which is too narrow or has too little overhead clearance.

Radiation

Radiation is transmission of heat through the air by rays. The heat may be radiated in all directions, horizontally as well as vertically (similar to heat radiated from a stove). Fuels too close to an intense heat can be ignited even if not touched by flame.

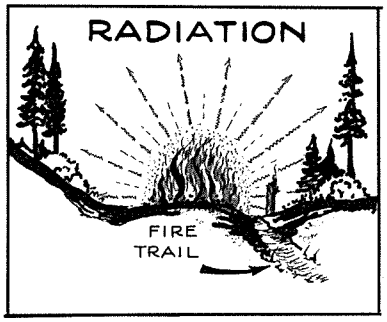


Fig. 128

Convection

Convection is transmission of heat by currents of air. These convection currents preheat the fuels ahead of a fire (across the fire line or above the fire line) and make them easier to ignite. If too close, fuels can actually be ignited by convection currents.

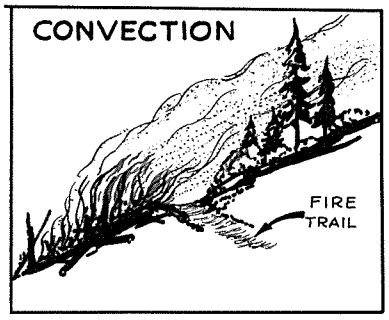


Fig. 129

FACTORS TO CONSIDER IN DECIDING LINE WIDTH ON EACH FIRE

Anything that has a definite effect on how a fire burns must be considered in deciding the width of line needed to hold or control the fire. The hotter or faster the fire burns, the wider the control line must be. Six important factors in determining line width are: fuel, slope, weather, part of fire, size of fire, and possibility of cooling.

Fuel

a. Kind of fuel

Some fuels burn hotter than others because they contain large amounts of inflammable oils. Greasewood (chamise), pines, and junipers are examples of oily, hot-burning fuels. The hotter the fuel burns, the wider the control line must be.

b. Height and density of fuels

(1) Ground fuels - heavy or light
(2) Overhead fuels - dense or open

Generally, the higher and denser the fuel, the higher and hotter the flame will burn and the wider the control line must be.

c. Size of fuels

As a general rule, the heavy fuels, such as sound logs, (not punky logs) heavy limbs, and thick-stemmed brush, do not ignite as easily and fires do not spread as fast as in the finer, lighter, and flashier fuels, such as grass, leaves, needles, and twigs. On the other hand, once they are ignited, logs, snags, and heavy branches burn very hot for a long time and may require wide control lines to keep the flame or radiated heat from igniting fuels across the line.

d. Condition of fuel

The condition of the fuel, whether it is dead or alive and, if alive, whether it is succulent, green, curing, or dry, has a definite effect on the burning rate or intensity of the flame. Generally, the drier the fuel the hotter it burns, and the wider the line must be; the greener or more succulent it is, the less intensely it burns, and the narrower the line can be.

Slope Or Topography

The slope where a fire is burning may vary from level to moderate or steep.

When a fire line is built above a fire burning on a slope, generally the steeper the slope the wider the line must be because the fire usually burns faster and more intensely; the more gentle the slope the narrower the line can be.

When a fire line is built below a fire burning on a slope the width of the line necessary does not depend so much on the slope, but trenching becomes important. Generally, the steeper the slope the deeper the trench must be, to prevent rolling burning material from crossing the fire line.

Weather Conditions

a. Temperature
b. Humidity
c. Fuel moisture
d. Air currents or wind

(1) Drafts created by fire (convection currents)
(2) Local wind

In general, the higher the temperature the lower the humidity; the lower the fuel moisture or the stronger the wind (air currents), the more intensely a fire will burn and the wider it is necessary to build the fire line.

The wind or air currents increase the burning intensity by supplying more oxygen, by moving currents of hot, drying air into the fuels ahead, or by actually carrying burning embers ahead of the fire itself. Therefore, the stronger the wind or convection current, the wider the line must be.

Part Of The Fire To Be Controlled

a. The head of the fire.
b. The flank of the fire.
c. The rear of the fire.

Generally, a fire burns hottest and with largest flames at the head, not as hot on the flanks, and with the least heat at the rear. Line width must therefore generally be widest at the head, may be narrower on the flanks, and may be narrowest at the rear.

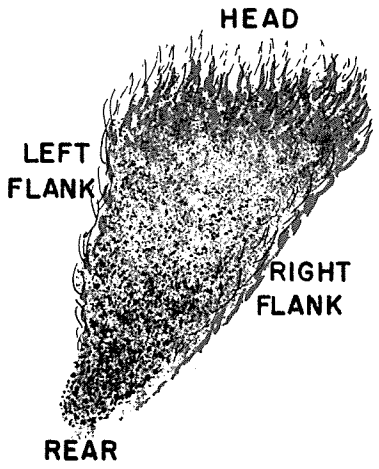


Fig. 130 Parts of a Fire

Size Of Fire Being Controlled

The amount of heat produced by the fire has a definite bearing on the width of line necessary to control the fire. A large fire is generally burning hotter than a small fire in the same type of fuel, and therefore the large fire may require a wider control line than the small fire.

Possibility Of Cooling The Fire

a. With dirt.
b. With water.

When plenty of water or dirt is available, generally a narrower line can be built because the flames can be cooled with water or dirt so they do not burn so intensely.

MINIMUM REQUIREMENTS FOR LINE WIDTH AND LINE DEPTH

Clearing

Brush, trees, and logs must be removed from a strip only wide enough to stop the initial spread of the fire, to permit safe working and to allow access when fire is hot.

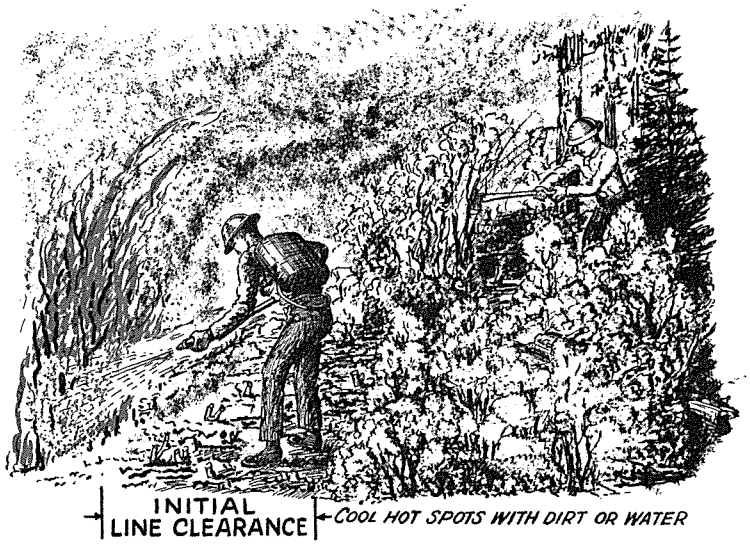


Fig. 131
Cleared Width Kept to a Minimum

Scraping

All inflammable material must be removed to mineral soil from a strip wide enough to prevent fuel from being ignited by heat or flame. (Duff burns with very little heat radiation, so only a narrow scraped strip through duff is necessary.) Scraped strip will be placed on out-side of cleared line.

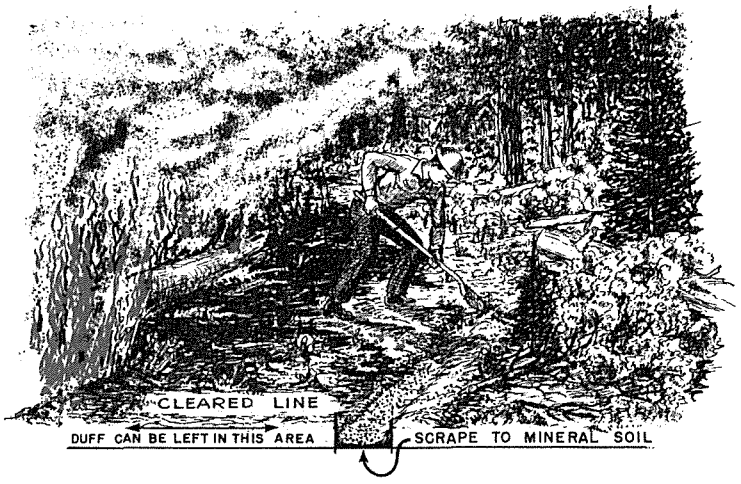


Fig. 132
Properly Scraped and Cleared Fire Line

APPROXIMATE LINE WIDTHS UNDER SPECIFIC SAMPLE CONDITIONS

Most times the necessary width of line will be governed by a combination of two or more of these factors -- (1) fuel (kind, height, density, size and condition), (2) slope, (3) weather condition (temperature, humidity, fuel moisture and wind), (4) part of fire being controlled, (5) size of fire being controlled, and (6) possibility of cooling the fire.

Certain conditions or factors are specifically mentioned in each of the following examples. Only those mentioned are to be considered in determining the line width. The other factors or conditions are assumed to be average and are not to be considered in the solution of the specific problem.

1. Flank Of Fire Burning In Pine Needles

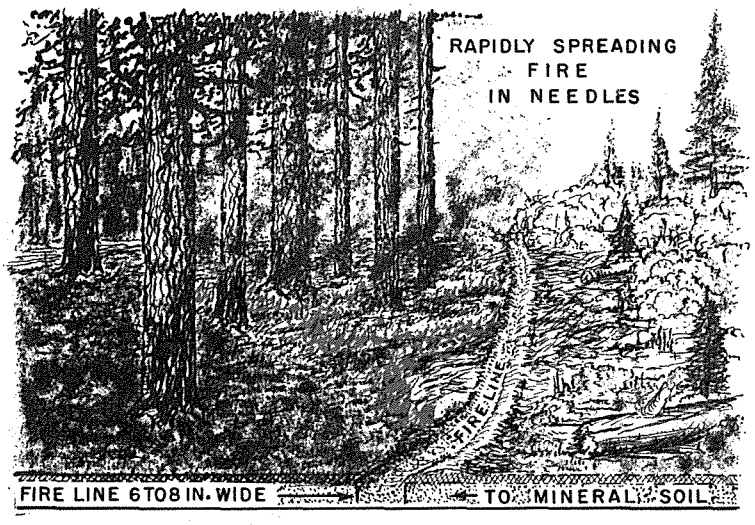


Fig. 133

Condition...

Flank of fire spreading rapidly through an average or medium cover of pine needles.

Line Width Necessary...

A narrow fire line 6 inches to 8 inches wide, scraped to mineral soil is generally sufficient on the flank. Flames are not high and heat not great in pine needles, so a wider line is generally not necessary to stop the fire. The line must be scraped to mineral soil to prevent smoldering across the line.

2. Head Of A Fire On Steep Slope In Open Timber

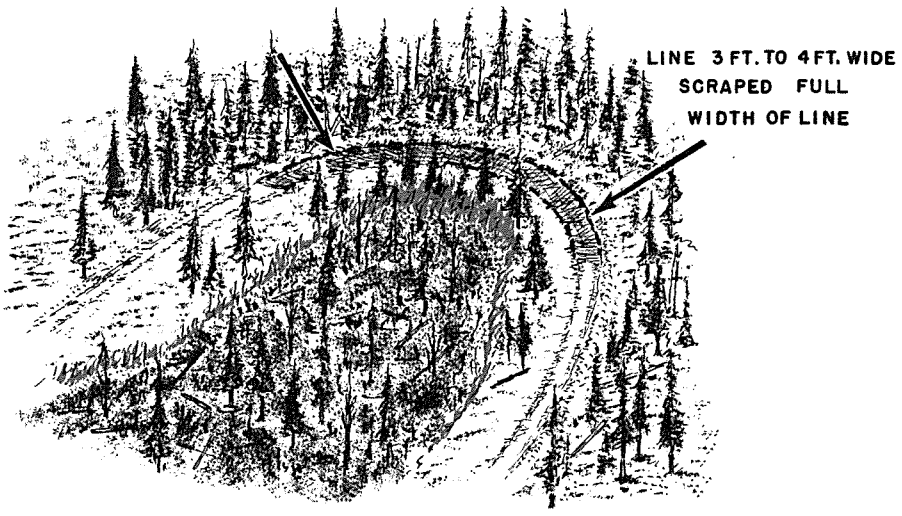


Fig. 134

Condition...

Head of fire spreading rapidly up steep slope in open timber. Most of burning fuel is pine needles - very few small trees.

Line Width Necessary...

A 3-to 4-foot line scraped full width should generally be sufficient at the head of a fire burning under these conditions. Because of the slope, the flames at the head of the fire will burn higher; radiation and convection currents will carry the heat ahead farther, thus requiring a wider line than in Problem 1. Because of the greater heat the line must be scraped full width at the head to prevent burning across the pine needles and duff.

3. Flank Of Fire In Brush Cover

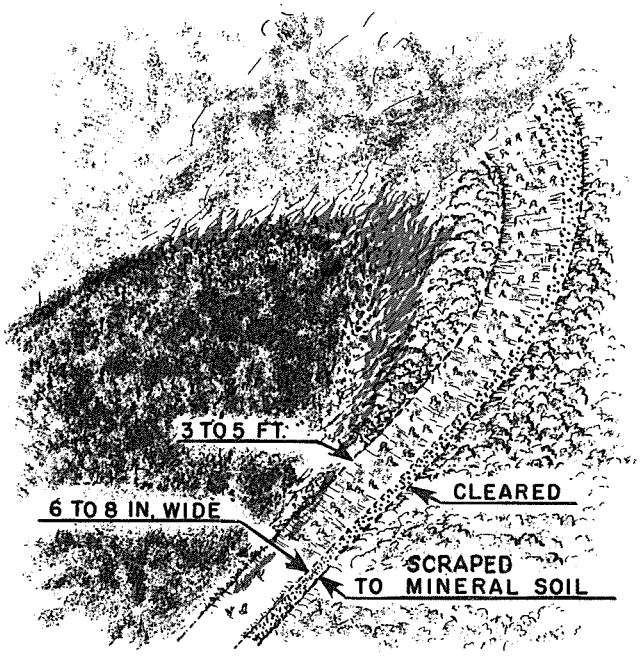


Fig. 135

Condition...

Flank of a slowly spreading fire in brush cover of average density and 3 to 5 feet high; flat ground.

Line Width Necessary...

Since brush is higher it burns with a higher flame than fire in pine needles and requires wider line clearance. A 3 to 5 foot clearance through average brush cover should generally be sufficient on the flank of a fire. If the brush were very dense and tall so that it burned very hot, it might be necessary to cut a wider line even on the flank of the fire. To prevent smoldering through the duff on the ground it is necessary to scrape a 6 to 8 inch width on the outside of the cleared strip. (This compares with the 6-8 inch scraped width in the pine needles.)

4. Head Of Fire In Brush Cover -- Fire Burning With Wind

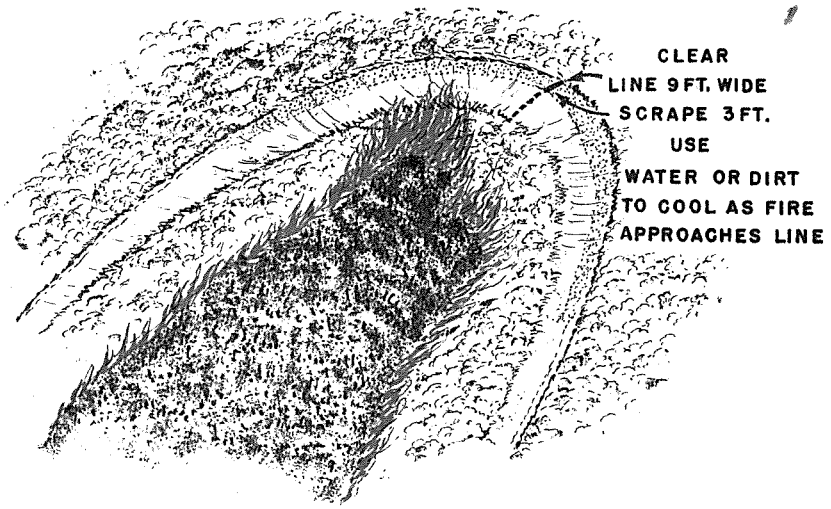


Fig. 136

Condition...

Same as Problem 3 except head of fire and gentle wind (8-12 M.P.H.).

Line Width Necessary...

Head of brush fire with gentle wind blowing requires a wider line width than under conditions of Problem 3. For these conditions a cleared width of about 9 feet would probably be sufficient, but dirt or water would have to be used to cool the fire as it approached the line. Denser or higher brush might require an even wider line. To prevent smoldering across the line through the duff it is necessary to scrape the outer 3 feet of the cleared width because of the intense heat of the brush fire.

REVIEW QUESTIONS -- STANDARDS OF LINE CONSTRUCTION

1. Why should you build the line only as wide as necessary to control the fire?

2. Name the four ways that fire can cross the line.

3. Name the six factors to consider, on each fire, when deciding how wide to make the line.

4. Which one of these factors can you control after the line has been located?

5. True or False: The scraped line is usually the full width of the line clearing.

6. You are building a line on the flank of a fire. Cover is pine needles. The line should be about _____ wide.

7. Same condition except cover is brush. Cleared width _____ _____. Scraped width _____.

CHAPTER VI

FIRE SUPPRESSION

FIRE SUPPRESSION

SUPPRESSION OF SMALL FIRES

INTRODUCTION

Forest Service Policy calls for:

Prompt, aggressive suppression action on all fires.
Using your full energies.
Staying with the fire until it is out unless relieved by superior authority.
Recognition of Safety responsibilities. (Refer to pages 181-187, Forest Service Safety Code.)

This section of the Handbook makes no attempt to teach or instruct in such fundamentals. What it does attempt is:

To depict small fire suppression problems which you commonly meet. Each problem covers one simple, readily identified situation.
To indicate the action required to solve each problem.
To state why the solution is correct.
To indicate when the same solution applies to other conditions than those assumed.

Studying The Problems Should Help You To Establish The Habit Of:

First looking at the fire as a whole.
Analyzing it into parts that will require different action.
Deciding on and using firefighting methods of proven worth on each part of the fire.

This section cannot, and does not attempt to tell you how to plan a campaign, when confronted by a lot of problems requiring big fire organization. That is, it will not train you to be a fire general. It should, however, help you decide what to do first and how to finish the job when a fire is small enough that you can tackle all the problems at one time.

SUPPRESSION PROBLEMS AND PRACTICES

Small fires cause the same kind of suppression problems and require the same kind of practices as larger fires. Most effective handling of small fires is done in successive steps. The steps in suppressing small fires are: First attack, Line Location, Line Construction, Backfiring, Mop-up, Patrol, and Abandoning the fire.

FIRST ATTACK

PRINCIPLES OF FIRST ATTACK

The first person arriving at a fire, or the person in charge of the first crew arriving at a fire is confronted with the problem of deciding what is the most important work to be done first and where the most effective work can be done. After a quick size up of the conditions within the fire, around the fire, and in the surrounding country toward which the fire is spreading, he chooses the point of first attack.

Size Up The Fire

How To Do It - Quickly...

Go around the fire, or find a vantage point and inspect the entire edge.

What To Look For...

Fuel burning adjacent to fire edge, particularly snags and logs, brush and thickets of reproduction.
Fuels in immediate path of fire.
Natural barriers. (Roads, streams, or barren ground)
Slopes
Spot fires.

Other Factors To Consider...

Weather conditions. (Wind, temperature, relative humidity)
Time of day.

Determine The Following...

Danger spots where fire is likely to flare up.
The most vital point of attack.
Can men work safely?
The cause of the fire. If man-caused, look for and preserve evidence. (See Prevention Chapter, page 9.)

Select Point Of First Attack And Make The Attack

The universal rules are:

Take prompt action on vital point.
Stay with the fire. Take most effective action possible with available forces and equipment.
Inform Dispatcher of situation by radio, so long as this does not interfere with control work.
Continue work day or night.

GOOD PRACTICES IN MAKING FIRST ATTACK

Use water or dirt for cooling down and extinguishing hot spots.
Anticipate future control action when fire cannot be put out promptly.
Follow-up temporary checking effort by putting in a permanent, clean, fire line to mineral soil.
Cut fire off from the most dangerous fuels as first effort, and prevent the fire from becoming established in explosive types of fuels, such as thickets of tree seedlings, heavy brush, slash areas.
Confine fire to one major area rather than let it develop two heads.
Locate and build lines and move all rollable material so it cannot roll across fire lines.
Leave no unburned islands or other areas of unburned material close to line.
To insure control within time limits, sacrifice area to make easy line construction and line that can be held.
Utilize existing barriers to full extent.
If whole fire can't be controlled, notify Dispatcher by radio

and then do some effective work on at least a part of the fire.

Where improvements (houses, other buildings, fences) are involved, consider all the facts before determining which point must be attacked first.

PROBLEMS IN FIRST ATTACK

The following conditions are assumed for all problems in First Attack, Line Location and Line Construction, except as otherwise specified in individual problems.

Attacking force consists of one man or a small crew.

Suitable hand tools and backpack pumps needed are available, but not tank trucks, or bulldozers.

Fire Danger is medium to high. Logs and snags and other fuels ignite easily, and burn hot. Fire will spread moderately fast, and will spot easily.

Time of day: Noon to mid-afternoon.

Dirt readily obtainable.

Portable radio available for on-the-line communication.

PROBLEM 1: USE OF DIRT IN FIRST ATTACK

Condition

Small hot fire burning in heavy fuels. Loose dirt available.

Fig. 137

Action Required

Throw dirt on flaming fuel (at base of flame) to cool fire, then encircle with line at edge of fire.

Why

Permits control of fire with minimum amount of line and with maximum speed. Cooling the fire first minimizes the danger of spot fires, and building the fire line at the edge of the fire did away with the necessity of burning out to the line.

Supplemental Action

Dirt is most effective when applied rapidly. If it is difficult to obtain, build up a small pile and then apply rapidly.

PROBLEM 2: USE OF WATER IN FIRST ATTACK

Fig. 138

Condition

Small, fast spreading fire in light fuels. Back pumps available.

Action Required

Spray water on the fuel at the base of the flame. Cool down fire, and follow-up immediately with clean line to mineral soil.

Why

Water spray permits rapid cooling of hot line and follow-up with hand tools. Fire line to mineral soil must be constructed, even though water stops the fire, to prevent fire from later coming to life and spreading after the water evaporates.

Water Use Principles

Spray is more effective than straight stream. Use only enough water to cool the fuel. Do not waste water.

PROBLEM 3: FIRE IN BASE OF SNAG

Fig. 139

Condition

Fire burning in fuel around base of snag, and just getting established in the base of the snag. No fire in the upper part of the snag.

Action Required

Extinguish fire in snag promptly. Use dirt or water to cool fuel. Scrape or chop out burning material with shovel or axe.

Why

To prevent fire from enveloping snag and showering sparks into unburned area, thus causing spot fires, or increasing area necessary to include within line.

Supplemental Action

The same solution applies to down logs in which fire is just getting a start.

PROBLEM 4: FIRE ESTABLISHED IN SNAG ABOVE BASE

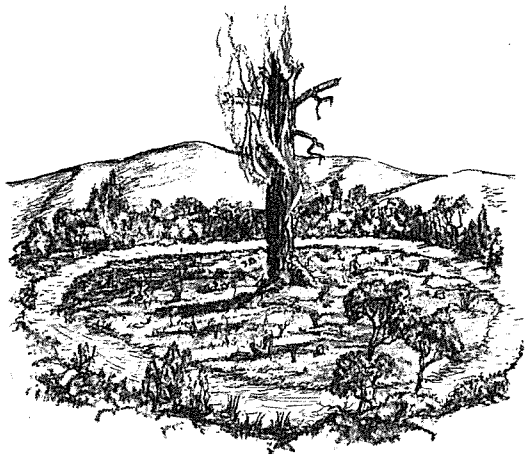


Fig. 140

Condition

Continuous fuel all around snag. No wind. Fire in snag burning briskly; too hot or too dangerous to fall snag. Level ground.

Action Required

Remove fuel from around snag. Be sure to cut and remove brush or reproduction for a radius sufficient to catch falling limbs or chunks. SAFETY NOTE: Be alert - avoid getting hit by falling material. After removing fuel, then drop back to 1 1/4 to 1 1/2 times height of snag, clear wide line, select time, and burn out inside line. This will make a clear space to catch snag when it falls. Watch for spot fires.

Why

To prevent falling burning material or the falling snag from spreading fire to surrounding area, and to prevent spot fires.

Supplemental Action

Situation same as described above, with danger of spotting at a minimum. Pile heavy fuels (limbs, etc.,) at base of snag to speed the burning down of the snag.

PROBLEM 5: FIRE IN TOP OF SNAG

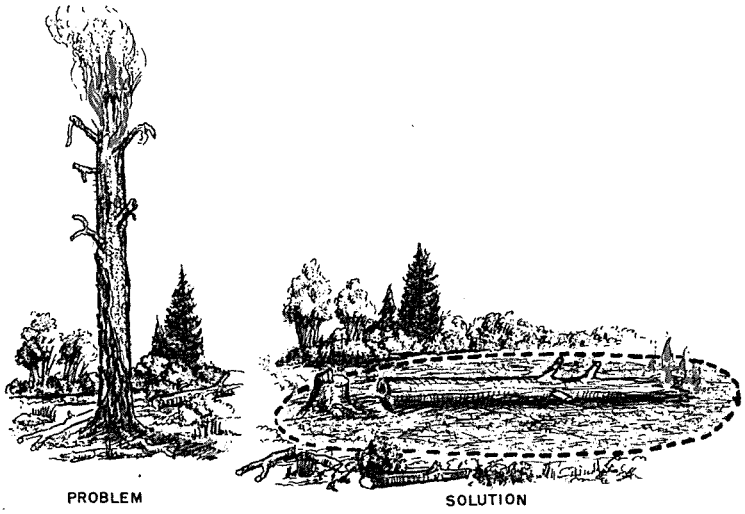


Fig. 141

Condition

Fuel in moderate quantity surrounding snag. Light wind. Snag burning in top. Snag can be felled safely. Level ground.

Action Required

Remove fuel from area large enough to catch snag, and then FALL THE SNAG and extinguish all fire in it by chopping out the burning wood. Extinguish with water and dirt. Watch for spots.

Why

To get fire on ground within reach of attacking force and to prevent spot fires.

Supplemental Action

Similar action should be taken to extinguish a fire in a spike-top green tree.

Safety Precaution

Post lookout to give fallers warning of falling tops or limbs. Plan and clear an escape route and go through a practice drill, "dry run" of running to escape a falling top or limb.

PROBLEM 6: FIRE SPREADING - ABOUT TO IGNITE SINGLE SNAG

Condition

Uniform cover over area.

Action Required

Control edge of fire nearest snag first. Cool heavy fuels, such as logs and fallen limbs, construct a fire line around the snag temporarily by use of dirt to prevent spread of fire to base of snag.

Why

To prevent fire from getting into snag.

Supplemental Action

Same solution applies where fire is spreading and about to ignite logs, dense brush, reproduction thicket, or slash.

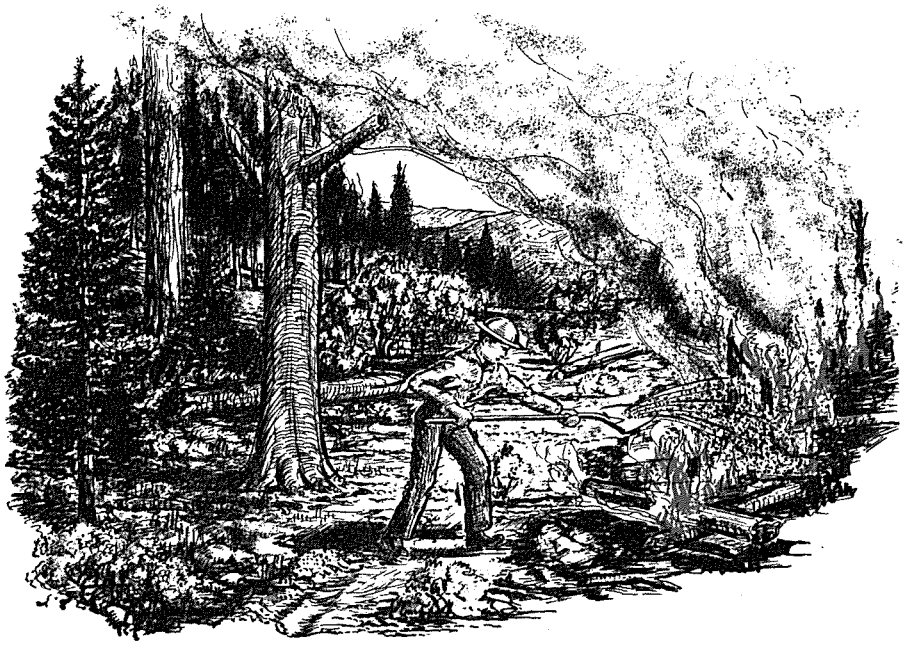


Fig. 142

PROBLEM 7: FIRE ABOUT TO CROWN IN REPRODUCTION OR BRUSH

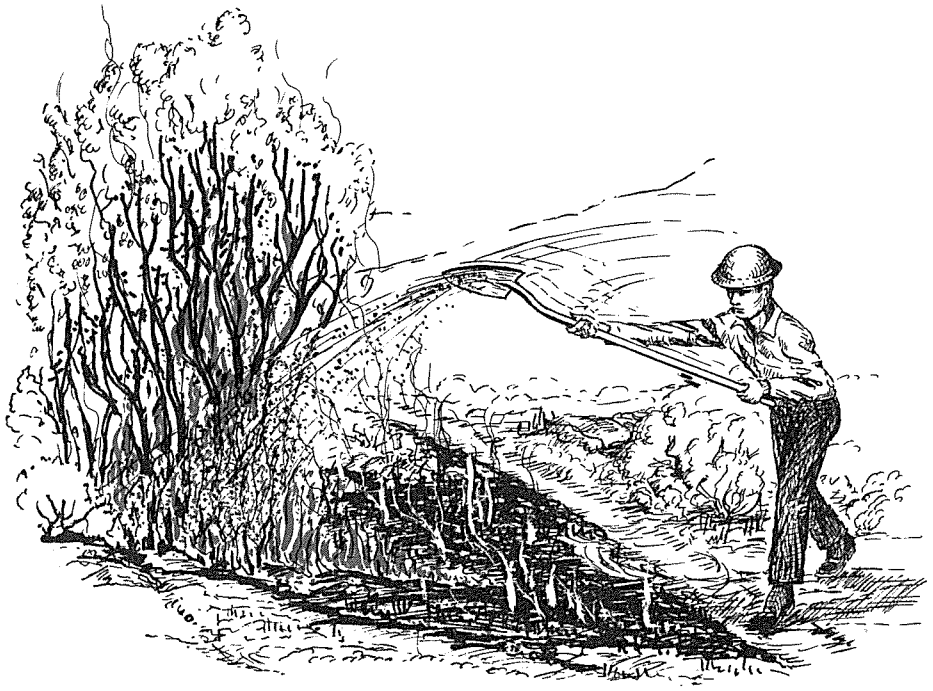


Fig. 143

Condition

Fire starting to burn briskly in base of reproduction or brush thicket. Just starting to crown. Plenty of dirt available.

Action Required

Throw dirt at base of fire to cut down heat and prevent crowning, even if burning material is well within planned control line.

Why

To reduce spot-fire danger, rate of spread, and possible loss of line. Crown fire can leap across a fire line.

Supplemental Action

Remove limbs and other fuel from in front of the fire to reduce heat and prevent crowning.

PROBLEM 8: USE OF TANKER IN INITIAL ATTACK

Condition

Small hot fire burning in heavy fuel, spreading fast, starting to crown in reproduction or brush. Tank truck available.

Action Required

Attack on flank near head of fire. Apply water at base of flame and work around to encircle the head of the fire. Use a spray directed parallel to fire edge. Shut off nozzle when moving between hot spots. Follow-up with control line to mineral soil, completely encircling the entire fire.

Why

Knock down the flame with water to permit rapid control line construction.

Water Use Principle

Use of spray increases efficiency and conserves water.

Fig. 144

PROBLEM 9: FIRE ON BOTH SIDES OF RAVINE -- ONE HEAD MARKEDLY LARGER THAN THE OTHER

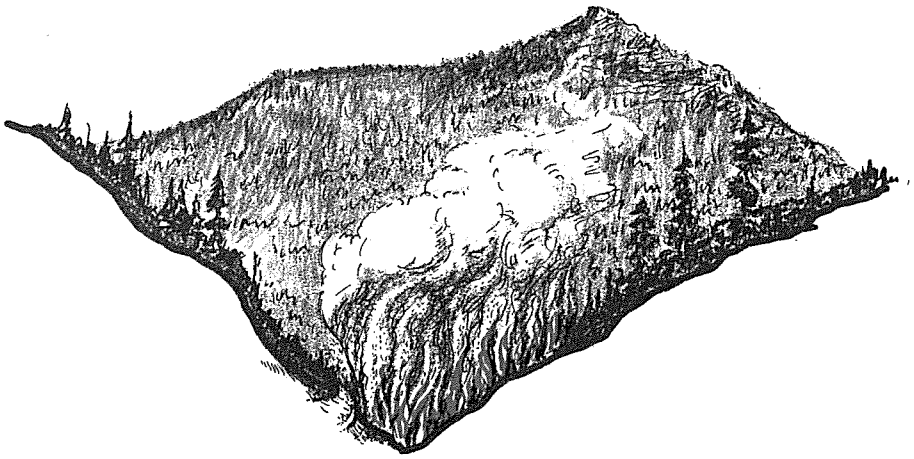


Fig. 145

Condition

Uniform conditions of cover, slope and spread.

Action Required

Control smaller head of fire first; then start control of other head.

Why

To hold fire to one side of ravine.

Supplemental Action

The same solution applies to other conditions: Where separate fires are burning on each side of ravine; where a single fire is just reaching or threatening to cross a ravine; or where fire is burning on both sides of a road or similar barrier.

PROBLEM 10: BURNING LOG LYING ALONG THE CONTOUR OF THE SLOPE

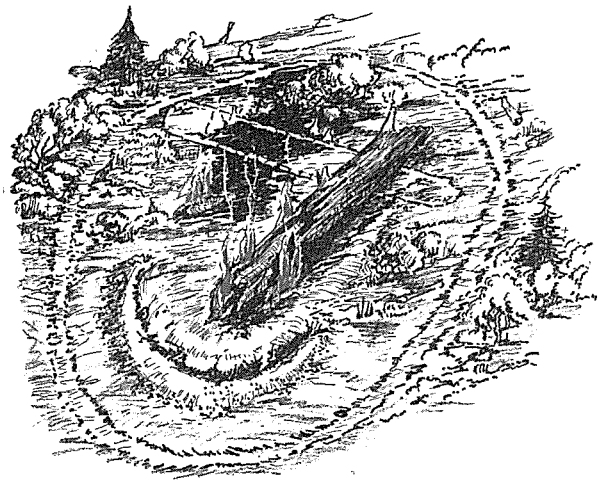


Fig. 146

Condition

Steep slope, good soil, water not available.

Action Required

Stop the spread with "scratch line", a hastily constructed, temporary fire line. Turn log around to lie up and downhill, roll it into prepared trench. If log is then too hot, cool it down temporarily with dirt, but don't leave it buried. Dig a trench around the lower end of log, deep enough to catch all rolling embers.

Why

To prevent the rolling of burning material down the slope. Cooling the fire prevents excessive production of sparks. It is not practicable to bury large logs deep enough to smother the fire. Buried logs may burn through dirt covering later and are likely to send sparks across the fire line.

Supplemental Action

If log is too heavy or too rotten to handle, dig deep trench below it -- deep enough to catch and hold the log if it rolls. To prevent rolling, the log can be blocked on lower side with rocks.

PROBLEM 11: LOWER EDGE OF FIRE LYING ALONG THE CONTOUR OF A STEEP SLOPE

Fig. 147

Condition

Considerable material that rolls readily, such as pine cones.

Action Required

Construct a deep trench, well banked with earth on its lower side, along the entire undercut portion of the fire line.

Why

To catch burning material and keep it from rolling across the control line into an unburned area.

PROBLEM 12: RAPIDLY SPREADING FIRE IN GRASS, NEEDLES, BEAR CLOVER, OR SIMILAR COVER

Fig. 148

Action Required

Use scratch line only to make first check of fire, completing line after rapid spread is stopped.

Why

To permit control of fire when building of safe final line in one operation cannot keep pace with spread.

Supplemental Action

Same result can often be obtained by cooling advancing edge of fire with dirt, or by use of water. In all cases it is necessary, finally, to construct a safe line.

PROBLEM 13: SMALL FIRE IN SMALL DENSE BRUSH PATCH SURROUNDED BY AREA WHERE LINE IS EASILY BUILT

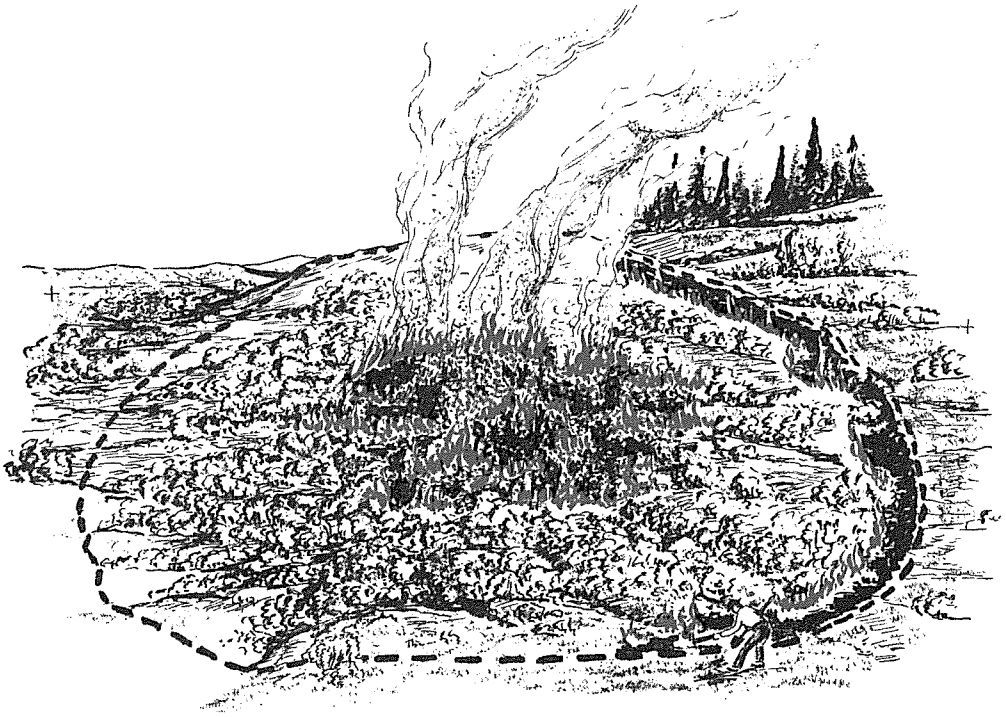


Fig. 149

Action Required

Drop back from dense brush and build line in more open cover where line can be constructed more easily and rapidly. Burn out the fuel inside the constructed line. This is called "clean burning" or "burning out".

Why

To encircle fire with line that can be more rapidly built and more easily held than in the brush.

Supplemental Action

Same type of problem exists if fire established in small pile of logs or slash, or dense patches of reproduction. Drop back from the heavy fuel and build the line in the open.

PROBLEM 14: FIRE BURNING NEAR SIDE OF ROAD, STREAM, OR OTHER BARRIER

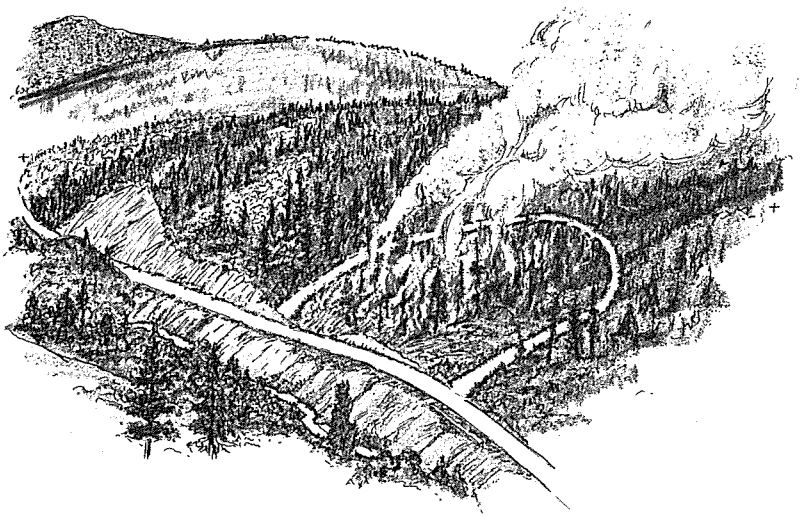


Fig. 150

Condition

Uniform slope and cover.

Action Required

First control fire on side away from barrier, allowing fire to burn to barrier or toward it, until side away from barrier is safe.

Why

To take advantage of existing barriers and thus reduce length of line to be constructed.

Supplemental Action

It is essential that clean burning be done along existing barriers before the fire is considered controlled, unless barriers are of sufficient width to insure safety against spot fires and flaring across line.

PROBLEM 15: SMALL FIRE IN LAVA BED COUNTRY

Condition

Fire established in lava cracks. Little dirt available. Water supply several miles from fire.

Action Required

Haul and pack water to put on fire until it is completely extinguished.

Why

It is impossible to build a continuous control line in this type of country, so the only sure method to control is with water.

PROBLEM 16: TWO OR MORE LIGHTNING FIRES THAT STARTED FAIRLY CLOSE TOGETHER ARE ASSIGNED TO THE SAME SMALL CREWS

Fig. 151

Condition

Little precipitation came with the storm. Fires accurately located by lookouts' reports and three men are assigned to the job. Other fires in District make prompt follow-up unlikely.

Action Required

All three will go to first fire, put it under control, leave one man to mop-up and the other two men will proceed to fire number two where the same procedure will be followed; when number two is controlled, the leader may proceed alone to fire number three.

PROBLEM 17: FIRE TO BIG FOR FIRST ATTACK TO CONTROL

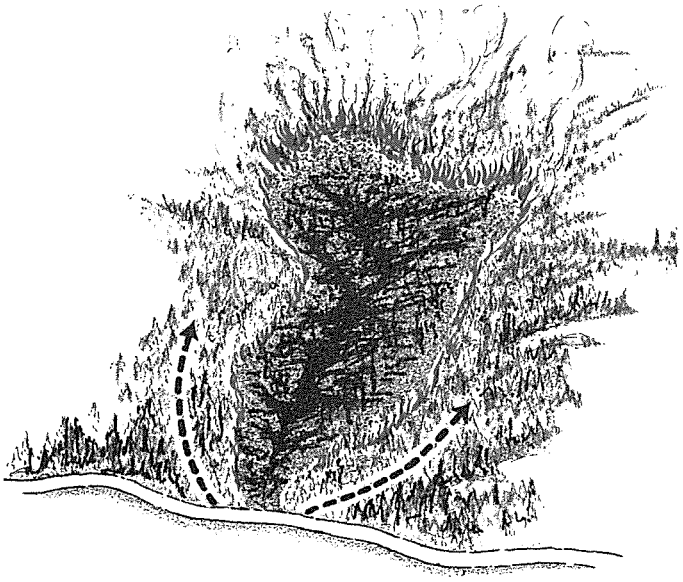


Fig. 152

Condition

Uniform cover and fire spreading fast. Fire too large and spreading too fast for initial attack crew to control.

Action Required

Report general fire situation to Dispatcher by radio immediately. Scout fire to have information available when follow-up crew arrives. Stay with fire. Begin work at rear of fire and proceed on rear and flanks until help arrives.

Why

Make time and effort effective in partial control instead of making futile efforts to head the fire.

Supplemental Action

If fire can surely be kept out of high-danger fuel with assured safety of crew, attack at such point. Cut off hot spots and fingers first and the connect pieces of line. This is called "Hot Spotting".

PROBLEM 18: FIRE IN BUILDING AND SPREADING TO FOREST

Fig. 153

Condition

Cover and slope are uniform. Fire well established in building and spreading to surrounding area.

Action Required

Control forest fire, selecting key point for attack. Do not waste efforts on building, if it has already caught fire and is beyond point of being saved.

Why

To hold fire and avoid danger of major forest fire, instead of making futile efforts to save property already doomed.

Supplemental Action

If fire is just beginning to start spot fires in the forest from flying sparks, put the spot fires out first. Watch for new spot fires to start, but concentrate effort on controlling or putting out the building fire.

Why

To save as much of the building as possible, prevent further spot fires in the forest and prevent spread to any adjacent buildings.

PROBLEM 19: BUILDINGS AND OTHER IMPROVEMENTS IN PATH OF ANGRY WOMEN

Condition

Slope and cover are uniform. Fire headed toward (a) dangerous cover, and (b) toward cabin, fence, or other similar property.

Action Required

First, control key point of forest fires. Consider improvements as possible key point in control of fire to prevent them from becoming involved and spreading the fire.

Why

To hold fire and avoid danger of a major forest fire.

Supplemental Action

If cover conditions are uniform and not highly hazardous, and very high improvement value is at stake, first attention to protection of such property is justified. Attention must be given to danger of spot fires, not only in the vegetation, but also spotting in the roof of a building.

REVIEW QUESTIONS - FIRST ATTACK

1. Why is it necessary to see the entire edge of a small fire before beginning work?

2. How does fireman determine point of first attack?

3. How does dirt aid in the control of a fire?

4. Name three most important dangers in snag fires.

5. Name three good practices when using water in the control of a fire.

6. Why is it necessary to build a clean line to mineral soil following the use of water to cool down a fire?

7. What is basis for determining point of first attack when fire in canyon bottom is just getting under way on both sides?

8. Why is it sometimes necessary to move logs which are well inside before completing the fire line?

9. What action is necessary to prevent fire from crossing the line on the lower side of a fire on a steep slope?

10. When is it good practice to build scratch (makeshift) line in first attack?

11. Under what circumstances is it necessary to "clean burn"?

12. What factors determine whether line should be built against fire edge or some distance farther away from fire edge?

13. When is it advisable to attack the fire at the rear and control the flanks first?

14. What action is necessary to prevent crowning in brush or reproduction?

LINE LOCATION

After the fire and the area ahead of it have been scouted, and key points for attack selected, the next questions is -- where to place the fire line.

PRINCIPLES OF LINE LOCATION

Locate line as near fire edges as possible.

Make line as short as possible.

Locate fire line so rolling material cannot cross.

Where fire is spreading rapidly or is very hot, or when gusty, shifty wind makes direct attack uncertain, locate line to give time for line construction and backfiring.

Locate lines to give uphill start to backfiring.

Block off high hazard types where possible by leaving them outside of fire lines.

Locate lines far enough from burning snags to enclose them when felled, and to catch sparks.

In high hazards types, locate line close to fire edge, even when very hot, if men can work safely for short periods.

Under similar conditions where men cannot work safely, back up to leave time for line construction and backfiring. Be sure that fire cannot burn around line and trap men.

Capitalize on all existing barriers in line locations.

Avoid sharp angles in line.

Select most open area for line location.

In country without definite topographic features, use oblique lines for frontal attack to pinch in the head of the fire, rather than a line squarely in front of head of fire.

Take advantage of normal daily shift between up-canyon and down-canyon drafts.

Fires generally burn up canyon during day and down canyon at night.

Encircle area where spot fires are so numerous as to make impractical to handle as individual fires.

PROBLEMS IN LINE LOCATION

PROBLEM 20: A FIRE BURNING ON A MODERATE TO STEEP SLOPE

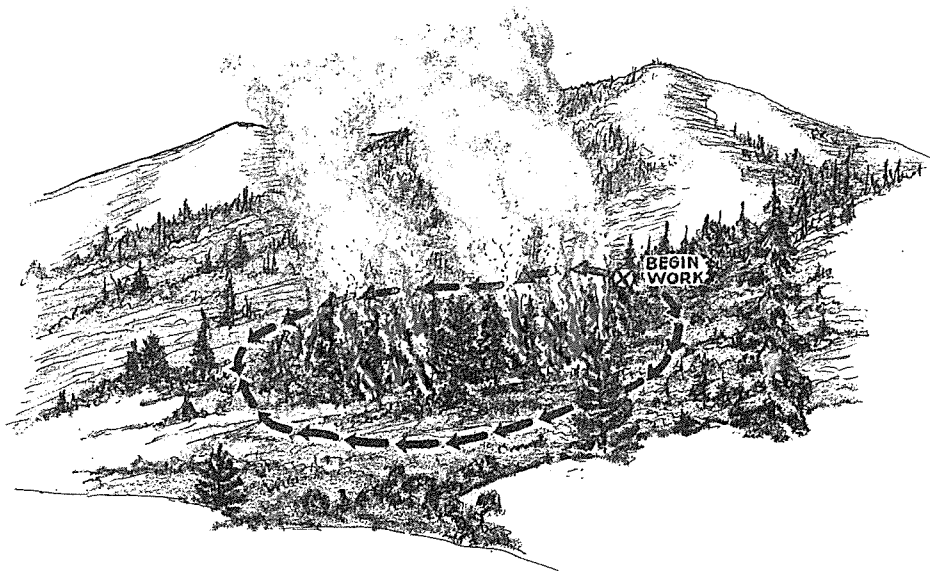


Fig. 154

Condition

Pine timber and scattered groups of reproduction, fire crowning only occasionally in reproduction clumps. Greatest rate of spread uphill.

Action Required

Fire should be attacked at head, then work down both sides of fire simultaneously to encircle fire at bottom. Locate line near or along edge of fire, clean burning where needed as line is built.

Why

To cut off point of most rapid spread.

PROBLEM 21: HOW TO LOCATE LINE TO CONTROL FIRES THAT SPREAD INTO A SERIES OF ELONGATED FINGERS

Condition

Fire has made fast runs and developed long fingers with unburned areas between. Fire has slowed down.

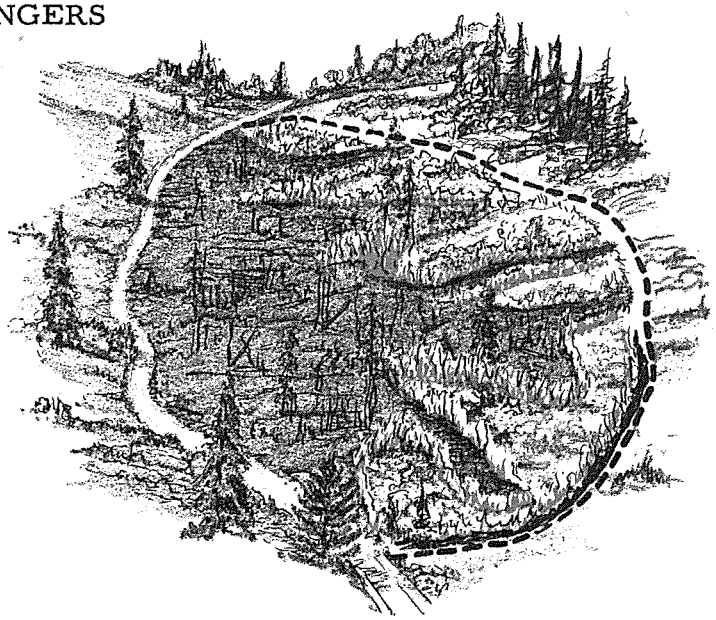


Fig. 155

Action Required

Tie ends of fingers together with shortest possible control line and burn out promptly between this line and the burned area.

Why

Control the fire with a reasonable expenditure of effort. The reduced length of control line will also be easier to hold.

Supplemental Action

1. Same problem exists when too many spot fires develop in limited area to control individually. Encircle them inside fire line.

2. If values such as plantation or areas of natural reproduction justify the additional expenditure, and weather conditions permit (high humidity), line may be located at the fire edge and fingers mopped up.

PROBLEM 22: HOW TO CONTROL REAR OF FIRE ON VERY STEEP SLOPE

Condition

Fire is about midway between the crest of the ridge and the ravine at the foot of the slope. No roads or trails traverse area. Wind moderate. Fire spread fairly rapid, mainly up slope; trenching very difficult because of rock. Much fuel that will roll causing fire to spread downhill. Stream in canyon bottom.

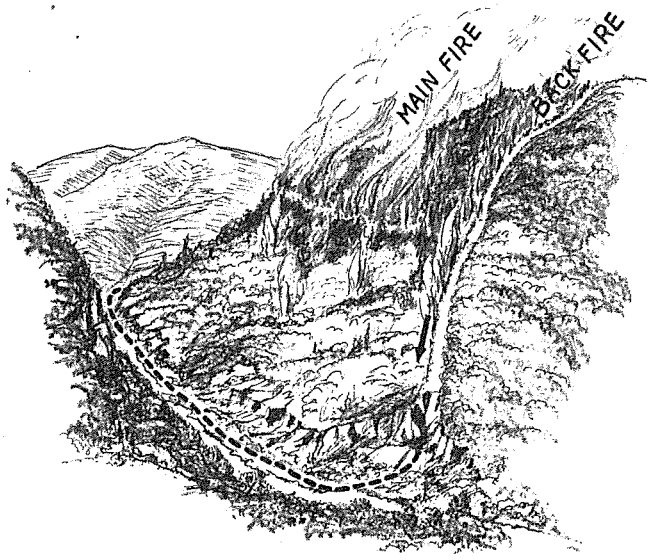


Fig. 156

Action Required

Locate line at base of slope; then start at top and bring line down both sides; backfire line promptly after construction. Locate flank lines so rolling material cannot cross. (Avoid undercut line.)

Why

To prevent loss of line due to burning material rolling over any line constructed below the fire on the steep side hill. Location at base allows more time for construction and backfiring and can be held more easily and certainly.

Supplemental Action

If fire has tendency to spread laterally at the bottom, it will be necessary to work from bottom up.

PROBLEM 23: HOW TO LOCATE LINE TO CONTROL LOWER FLANK OF FIRE ON STEEP GROUND

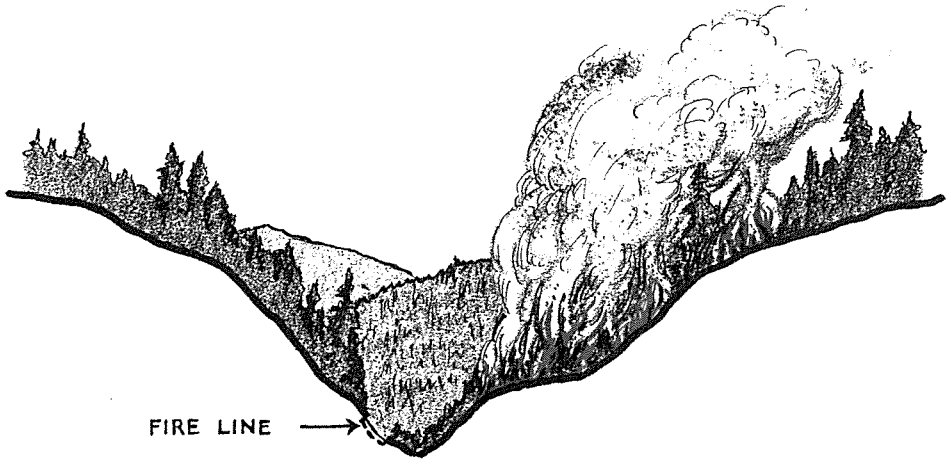


Fig. 157

Condition

Cover brush or timber. Spread medium. Ravine dry. Side slopes steep. Wind has driven fire diagonally up slope.

Action Required

Locate line on opposite side of draw from rear of fire; proceed along ravine until rolling material from head of fire cannot cross rear line; locate line up flank, converging on head of fire.

Why

To prevent burning material from rolling over control line.

Supplemental Action

Keep line as near the bottom of the draw as possible. Reduce volume of heat when burning out.

PROBLEM 24: HOW TO LOCATE CONTROL LINE ACCORDING TO EXISTING AND EXPECTED RATE OF SPREAD

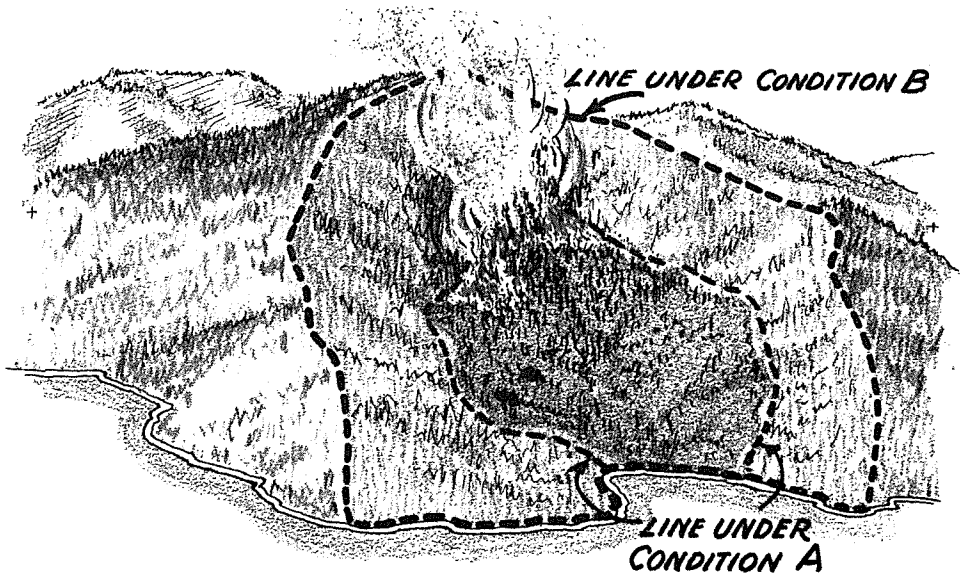


Fig. 158

Condition A - No change in spread likely.

Fire established on moderate slope. Moderately dense, uniform cover on entire slope. Wind direction steady. Rate of spread medium. Edge of fire fairly straight. No serious danger of rolling; wind not likely to change direction for several hours.

Action Required

Locate line as near edge of fire as heat will permit, burning out as line is built.

Why

Conditions predictable far enough in advance to insure holding of line; shortest line most quickly completed by working close to fire.

Supplemental Action

"Safety Precaution": Plan escape routes to avoid traps in event of a flanking spread or blow-up. Overhead and crew must understand the plan.

Condition B - Spread likely to change suddenly.

Fire conditions as above, EXCEPT wind gusty, sudden changes in direction, spread of fire by spurts, edge of fire irregular. Outlook: Wind direction likely to switch at any moment, gustiness likely to continue.

Action Required

On each flank of fire, drop back to side spur or ravine far enough from fire so that, with men and tools available, entire line can be built and backfired before fire reaches any part of line. Necessary to estimate behavior of fire for definite period.

Why

Gusty, unpredictable wind makes fires especially tricky. Fire could cross a line built too close to fire edge.

Supplemental Action

"Safety Precaution": In dense cover such as heavy brush types, consideration must be given to the safety of crews that will be working on lines ahead of the fire. Plan escape route to avoid traps in event of sudden change of wind or blow up.

PROBLEM 25: HOW TO CONTROL HEAD OF FIRE BURNING UP SLOPE AND NEARING SHARP CREST OF RIDGE

Fig. 159

Condition

Fire running uphill rapidly in moderately dense brush or reproduction.

Action Required

Drop just over crest of ridge away from slope on which fire is running and build line. Trench if necessary to prevent rolling material from getting over line. Clean burn promptly after construction.

Why

To provide a wide line when fire reaches crest; to prevent main fire from sweeping over control line; to permit clean burning of line with initial uphill run of backfire; take advantage of counterdraft that will slow up main fire and cause sparks to fall back in burned area.

PROBLEM 26: HOW TO LOCATE CONTROL LINE WHEN FUEL TYPE OUTSIDE FIRE CHANGES MARKEDLY

Fig. 160

Condition

Fire established in mature mixed timber type. Spread moderate. Wind direction steady. Dense fuel with many snags and down logs some distance ahead of fire. Direct attack of fire impossible or dangerous.

Action Required

Locate line in timber, far enough from edge of snag patch, so that under existing conditions spotting into snag area unlikely. Locate as close to fire edge as possible, leaving time to complete and burn out line.

Why

Resistance to control in snag area greater than in green timber. Key action is to confine fire to green timber.

Supplemental Action

Solution is same where fire threatens to move from any fuel type with low resistance to control, to any type with greater resistance to control; for example, fire moving from grass toward brush or from open mature timber toward dense reproduction.

PROBLEM 27: HOW TO LOCATE LINE WITH REFERENCE TO BURNING SNAGS INSIDE FIRE

Fig. 161

Condition

Topography level. Wind light. Rate of spread moderate. Snags burning too hot to cut down.

Action Required

Locate line far enough from fire to catch blowing sparks and embers coming from burning snags, and to enclose snags themselves when they fall or are cut. Maintain constant watch for spot fires.

Why

To prevent loss of line caused by embers blowing into unburned area, or by the snags falling.

PROBLEM 28: HOW HEAT OF FIRE AFFECTS DISTANCE OF CONTROL LINE FROM FIRE EDGE

Fig. 162

Condition A

A small fire is established in part of a large area of slash and threatens the entire area. There is a road near the flank and skid trails near the head of the fire. These may slow down the fire, but will not stop the fire. Fire can be held at the skid trail if effort of workers is concentrated at the head. Heat is uncomfortable, but not unbearable for a few minutes at a time.

Action Required

Make every effort to stop the fire at the road and skid trails. Use dirt and water to cool down fire at edge of skid trail, using individual workers very short periods at a time. Then alternate with other workers.

Why

Facing hot fire is necessary to prevent fire from crossing skid trail and creating major fire involving whole slash area. No danger to men, since ways of escape are open. Utilizes existing barrier.

Supplemental Action

Similar action may be necessary to keep hot fire (a) from getting into any heavy fuels where line construction may become much more difficult; or (b) from burning any structures that might be in the path of the fire.

Condition B

Fire established in large, dense brushfield, full of down logs. No barrier near fire edge. Night time. Rate of spread slow, but volume of heat great.

Action Required

Locate line beyond zone of intense heat, but close enough to minimize length of line.

Why

Nothing to be gained by making work needlessly uncomfortable by working too close to fire edge.

Supplemental Action

Same problem with any slow spreading, but very hot fire, where key to solution is sureness rather than speed of control.

PROBLEM 29: HOW TO LOCATE LINES WITH REFERENCE TO NATURAL OR MAN-MADE BARRIERS

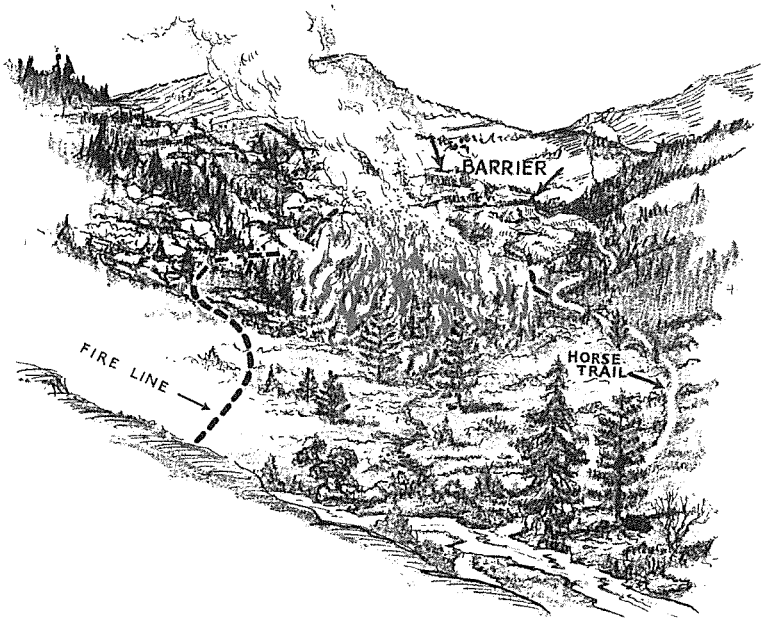


Fig. 163

Condition

Fire burning just above canyon in steep country. On one spur extending to canyon is a trail leading from the main ridge which parallels canyon; along this ridge is a series of large rock outcrops making a barrier which will at least temporarily stop main head of fire.

Action Required

Utilize the trail as a control line on the one side and tie the bluffs together at the top with a control line. Locate necessary fire line from natural rock outcropping to canyon bottom barrier.

Why

The use of existing natural or man-made barriers as parts of control line expedites the control of a fire by reducing the size of the job. Trails, roads, streams, barren areas, and firebreaks usually make easier and safer lines to patrol.

PROBLEM 30: HOW TO LOCATE LINES TO CONTROL NARROW HEAD OF FIRE, TOO HOT FOR DIRECT FRONTAL ATTACK

Fig. 164

Condition

Rapid rate of spread up steep slope; uniform fuel; mature timber; considerable amount of young trees.

Action Required

Locate and construct line by flanking attack around head of fire, avoiding sharp angles.

Why

When there is a sharp bend in a line around the head of a hot fire, danger of spotting is increased greatly since the intensity of the fire is concentrated at a point instead of being distributed along a wider front. Also, wind from any one of three directions will tend to blow the fire over some portion of the line in the vicinity of the sharp angle.

Supplemental Action

Line location along trails, roads, ridges, or streams with sharp angles should likewise be avoided.

PROBLEM 31: HOW TO LOCATE LINE IN COUNTRY OF VARIED COVER AND TOPOGRAPHIC CONDITION

Fig. 165

Condition

Fire burning on moderate slope with occasional bluff and rock outcrops; cover varied patches of heavy brush, woodland areas, and open timber.

Action Required

Locate line in most open cover within practicable distance of fire considering its probable rate of spread. Avoid heavy cover and areas so rough as to make line construction slow and difficult.

Why

To facilitate the construction and holding of the line with the minimum effort and the maximum of possibility of success; to obtain sureness of control even at a possible sacrifice of area.

PROBLEM 32: HOW TO LOCATE LINE TO CONTROL FIRE MOVING FORWARD ALONG A UNIFORM FRONT, BURNING TOO HOT FOR CLOSE FRONTAL ATTACK

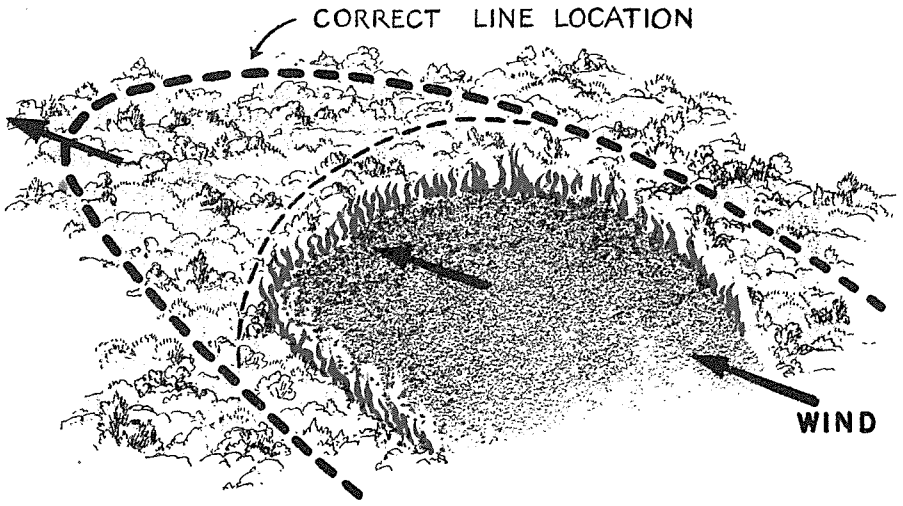


Fig. 166

Condition

Uniform dense brush cover. Level ground. No topographical features, such as ridges and ravines, to influence location of line. Fire any size. Rate of spread rapid and expected to continue.

Action Required

Locate line a sufficient distance ahead of the fire front so that there is ample time to build and backfire before the front of the fire reaches it. Locate the line at an angle to axis of fire spread, so that only a small portion of main front will hit line or backfire during any given short period.

Why

To reduce the size of the fire front that must be stopped by the control line at any given time.

PROBLEM 33: HOW TO TAKE ADVANTAGE OF NORMAL SHIFT OF WIND DIRECTION IN CANYONS

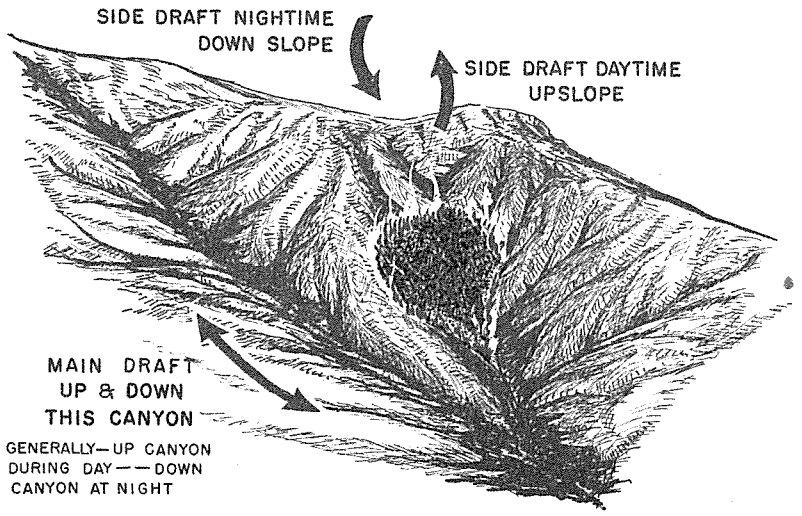


Fig. 167

Condition

Time -- early evening. Hour of day approaching for normal shift of wind from up-canyon draft to down-canyon draft. No extreme conditions of cover or weather. Fire in broad canyon. Fire can be controlled without difficulty with forces available before midnight.

Action Required

Locate line for first work on the down-canyon side of fire out of heat and smoke. When the wind shifts to down-canyon drafts, locate line for working the head and up-canyon side.

Why

Successively working sections of the fire while they are quiet permits more effective production of line by allowing men to work under conditions of minimum heat and smoke; and permits line to be more easily held. Line first worked has cooled down and requires minimum attention to prevent loss when the wind shifts to down-canyon direction. The portion of fire which was the head on arrival becomes the rear when the wind shift occurs and can be attacked more easily.

REVIEW QUESTIONS - LINE LOCATION

1. What factors determine how far ahead of a fire the line should be located?

2. Where should control line be located on fires having long fingers?

3. Where should line be located on lower side of a fire on very steep slope when that side is relatively near canyon bottom? Why?

4. When line must be located along bottom of steep-sided canyon, where should it be built -- on side next to fire, on very bottom, or on side away from fire? Why?

5. How does accumulation of heavy fuel, snag clusters, etc., influence the location of line? Why?

6. Why is it necessary to avoid sharp angles when locating line to control a hot burning fire?

7. What good practices of line location result in speeding actual rate of line construction?

8. Where should line ordinarily be located on a fire spreading in slash or old burn, when head is approaching large body of heavy green timber?

9. Where should line ordinarily be located if fire is burning in green timber and nearing edge of old burn or other fuel type with high rate of spread or high resistance to control?

10. Where is line located when burning snags inside are too hot to cut down?

11. What is the proper location for a line to control the head of a fire burning up slope and near crest of ridge? Why?

12. How should line be located to control narrow head of fire

spreading rapidly up long, steep slope of unbroken fuel?

13. In steep, narrow canyon, wind may be expected to make certain daily shifts in direction. How does this affect location of lines?

14. What factors should the line locator consider in order to insure the safety of line crews?

LINE CONSTRUCTION

PRINCIPLES OF LINE CONSTRUCTION

1. Make line no wider than necessary.

2. Clean all lines to mineral soil for all or part of width.

3. Scatter charred or burning material from line construction inside the burned area.

4. Unburned material from line construction:

   (a) Scatter whichever way is easiest and fastest, provided this does not make line too hard to hold or complicate mop-up.

   (b) If fuel is needed for backfiring, place inside the line.

5. Protect undercut lines against rolling material.

6. Effectiveness of a given width of line can be increased by using dirt or water to cool down adjacent fire.

7. Rotten logs or stumps just outside the line should be covered with dirt or wet down if water is available.

PROBLEMS IN LINE CONSTRUCTION

PROBLEM 34: HOW TO DISPOSE OF MATERIAL REMOVED IN LINE CONSTRUCTION

Condition A

Work can be done directly on the fire edge because it is spreading slowly.

Fig. 168

Action Required

All burning or charred material should be scraped into the burned area. Unburned material should be put on the outside of the line. The charred or burning fuel should be well scattered in the burn.

Condition B

Line must be constructed some distance away from the edge of the fire.

Action Required

If the removed cover is light, it should be thrown whichever way will make for most rapid line construction, care being taken not to build up heavy piles of fuel inside the line and close thereto. If the fuel is needed in backfiring, it should be placed inside the line.

Why

To avoid building up the supply of fuel close to the line with consequent increased danger of the fire getting across; to dispose of material in easiest way.

PROBLEM 35: HOW TO USE RELATIVELY NARROW LINE TO SPEED CONTROL

Fig. 169

Condition

Line narrower than desirable through stand of tree and reproduction seedlings, which must be backfired or to which fire will spread. Considerable danger of spotting or flaring over line.

Action Required

Throw dirt or use water to keep fire out of tree crowns immediately adjacent to line.

Why

To reduce intensity of burning and to minimize danger of spotting or crowning over line.

Supplemental Action

Same problem if fire is burning in brush.

PROBLEM 36: PROTECTING MOST INFLAMMABLE FUEL OUTSIDE FIRE LINE

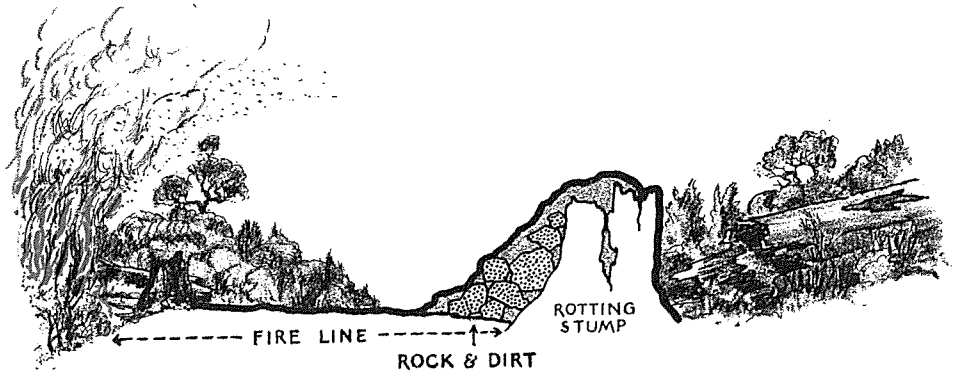


Fig. 170

Fig. 171

Condition

Fire close to rotten stumps or logs which are outside of line and not burning.

Action Required

Cover stump and logs with dirt or wet down with water if available.

Why

Such fuels most dangerous focal point for spot fires.

PROBLEM 37: HOW TO TRENCH BELOW A FIRE ON A SLOPE

Fig. 172

Condition

Fire backing down moderate slope in needles. Cones, scattered wood fragments, and other materials may roll readily. Undercut line needed. Dirt available.

Action Required

Convert fire line into a trench by excavating clean mineral soil and piling along lower edge. Duff may be used to form part of berm, but should be completely covered with mineral soil.

Why

To catch hot rolling material which may spread fire across line.

Supplemental Action

Whenever possible logs should be moved to lie up and down the slope, or else blocked to prevent rolling; this reduces the amount of trenching necessary.

PROBLEM 38: HOW TO BUILD TRENCH TO HANDLE ROLLING MATERIAL IN ROCKY COUNTRY

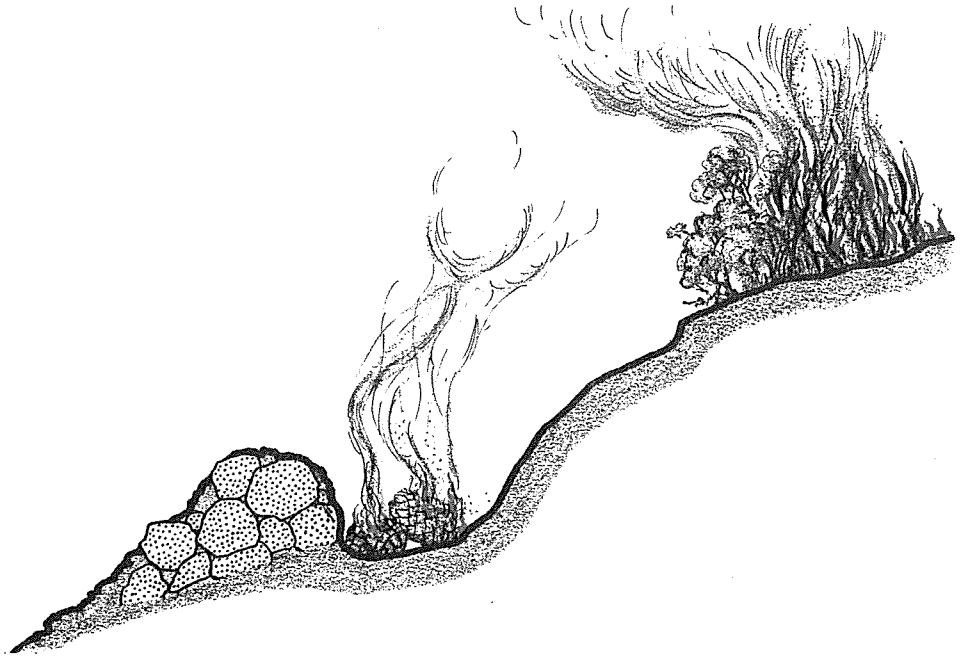


Fig. 173

Condition

Fire on steep rocky slope, with material that will roll when disturbed by fire, and undercut line necessary.

Action Required

Convert fire line into trench as in previous problem, using stones, small logs, or other debris to form foundation of berm. Cover face with mineral earth. If necessary, use trees, stakes, or stones to hold logs in place.

Why

To build effective barrier against rolling material faster than is possible with dirt alone.

PROBLEM 39: EFFECTIVE USE OF FIREBREAK

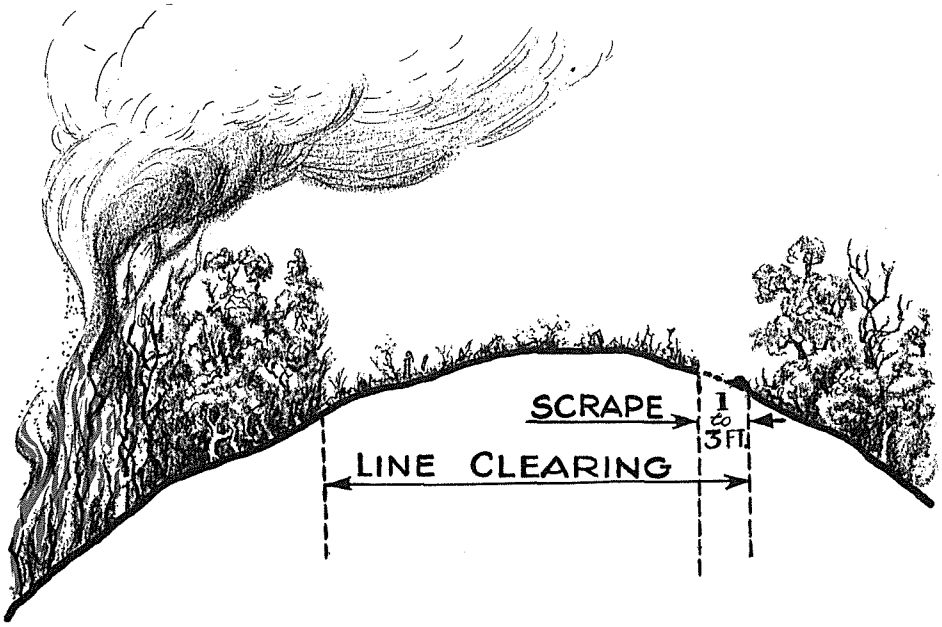


Fig. 174

Condition

Firebreak to be backfired. Light cover of grass and weeds on break.

Action Required

Before backfiring, clear fuel from break on strip one to three feet wide on edge of break away from fire.

Why

To obtain full effectiveness of entire width of break.

Supplemental Action

Same principle applies when constructing control line in heavy brush or reproduction.

SPECIAL LINE CONSTRUCTION METHODS

Cold Trailing

To cold trail is to build a line along the edge of a fire that has ceased to crown and is smoldering in duff or low ground cover. Brush or other high material is cut off and the trail is cleared to mineral earth. Ordinarily, clearing can be relatively narrow (one-half the height of the brush up to 3 or 4 feet is a good guide) and is constructed half in the burn and half outside. All smoldering or charred brush should be thrown well back in the burn. Green brush should be thrown outside. Duff is scraped into the burn and scattered.

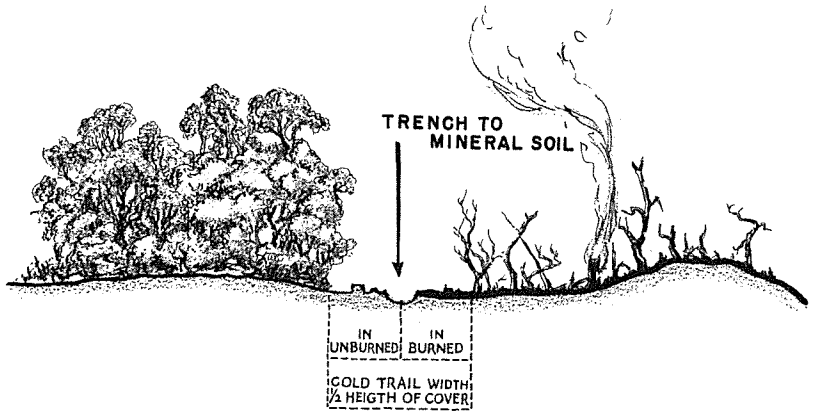


Fig. 175

In cold trailing be sure that:

1. No embers are cast into unburned area.
2. Charred and smoldering material (both brush and duff) are well scattered to prevent later flare up.
3. No fingers of smoldering material are overlooked.
4. Material left inside of line is not in contact with live fire or is so thoroughly burned that it cannot flare up; otherwise cut it out and scatter.
5. Islands of unburned or singed material are cut off and scattered, or the islands are cold trailed.
6. The trail is trenched to mineral soil and clean of leaves, twigs, and roots.
7. On undercut lines trenches are dug if there is any chance of burned material rolling across line.

Feeling Out

In low and thin cover, such as open stands of chamise, cold trailing need be done only on those sections of the edge of the fire at which signs of fire can readily be found. Sections that appear to be dead are not cold trailed, but are carefully gone over by an experienced man who feels the edge of the burn with his bare fingers to be sure that no fire is overlooked. Feeling out can save vast quantities of work, but must be done by an experienced and reliable man; and the line must be checked frequently for signs of fire. It should not be relied upon in areas of deep duff. Safety Precaution: Proceed with care -- serious burns may result if hand is plunged into hot masses of coals.

Hot Spotting

Hot spotting is a special practice of constructing short sections of line to check or stop the spread of parts of the main fire. It is done at critical points or "hot spots" on the fire in advance of regular fire line construction. It may be done under the following situations: (See Problem 41.)

a. During initial attack; to check the spread of small heads or or fingers of the fire which will become more difficult to control; to prevent fire from getting into (1) fuels in which the fire will burn faster, (2) heavy masses of fuel such as logs or snags, (3) fuels where line construction will be more difficult (4) fuels on steeper slopes.
b. On a sector of large fire; in advance of line-construction crew to keep fire within planned limits.
c. In advance of cold trailing; small crews are sent ahead to dangerous points on the edge of fire to check localized flare-ups.

PROBLEM 40: USE OF COLD TRAIL AND FEELING OUT

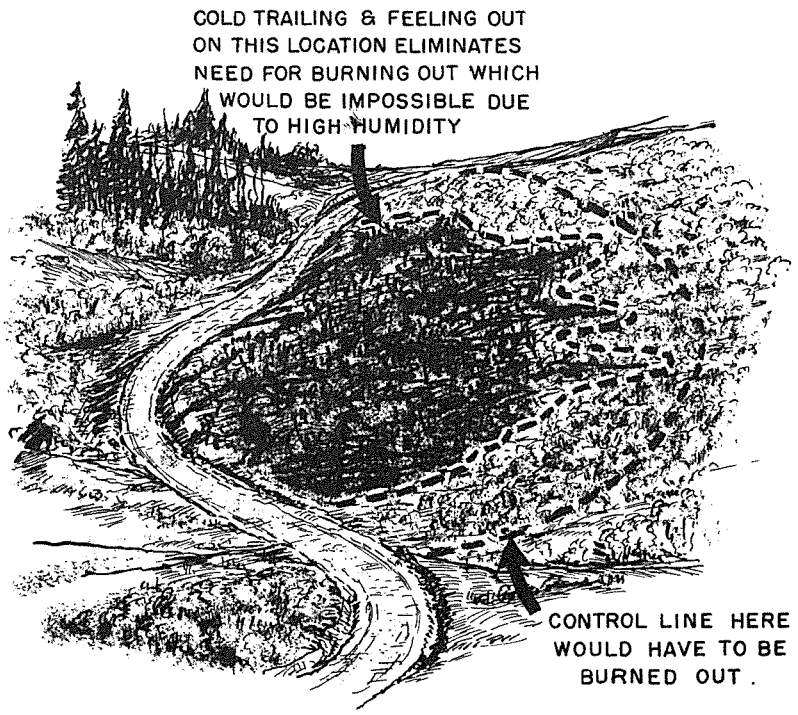


Fig. 176

Condition

Fire has made a run in chamise on moderate slope under conditions of high wind and low humidity. Wind has died down and humidity increased. Fire has stopped spreading.

Action Required

Cold trail hot edge of fire. Feel out sections that appear to be cold. Trench undercut line.

Why

Burning out is impracticable because of high humidity. Cold trailing is necessary to prevent fire flaring up and possibly slopping over when humidity drops and wind comes up. Feeling out doubtful portions of the line will save much work.

PROBLEM 41: HOT SPOTTING -- USING TEMPORARY LINES TO CHECK FIRE AND GAIN TIME

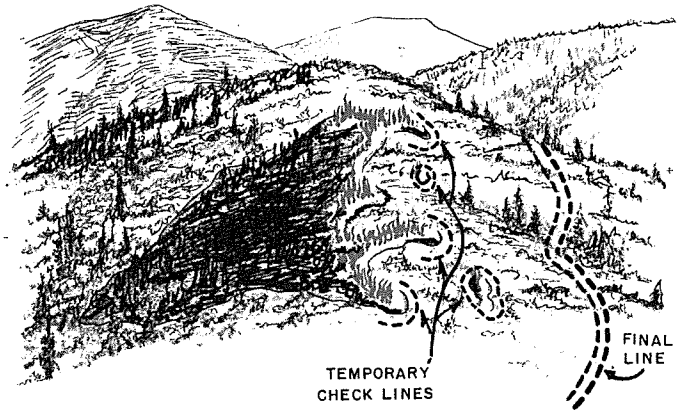


Fig. 177

Condition A

Major fire has run up steep heavy brush slope and has slopped over crest in stringers and spots too ragged and numerous to control by direct attack. Considerable time needed to prepare line in advance of fire and await favorable conditions for backfiring.

Action Required

Put a temporary check line around the threatening stringers and spot fires to hold them in check while constructing backfire line.

Why

To gain time for location and construction of final line and permit selection of proper time for backfiring.

Condition B

Fire in pine needles, duff, or grass. Forces available are insufficient to construct final control line at once.

Action Required

Put in temporary line. Later, strengthen line or build new and final line if first line lost.

PROBLEM 42: HOW TO KEEP FIRE OUT OF SNAGS THAT ARE LEFT INSIDE THE CONTROL LINE

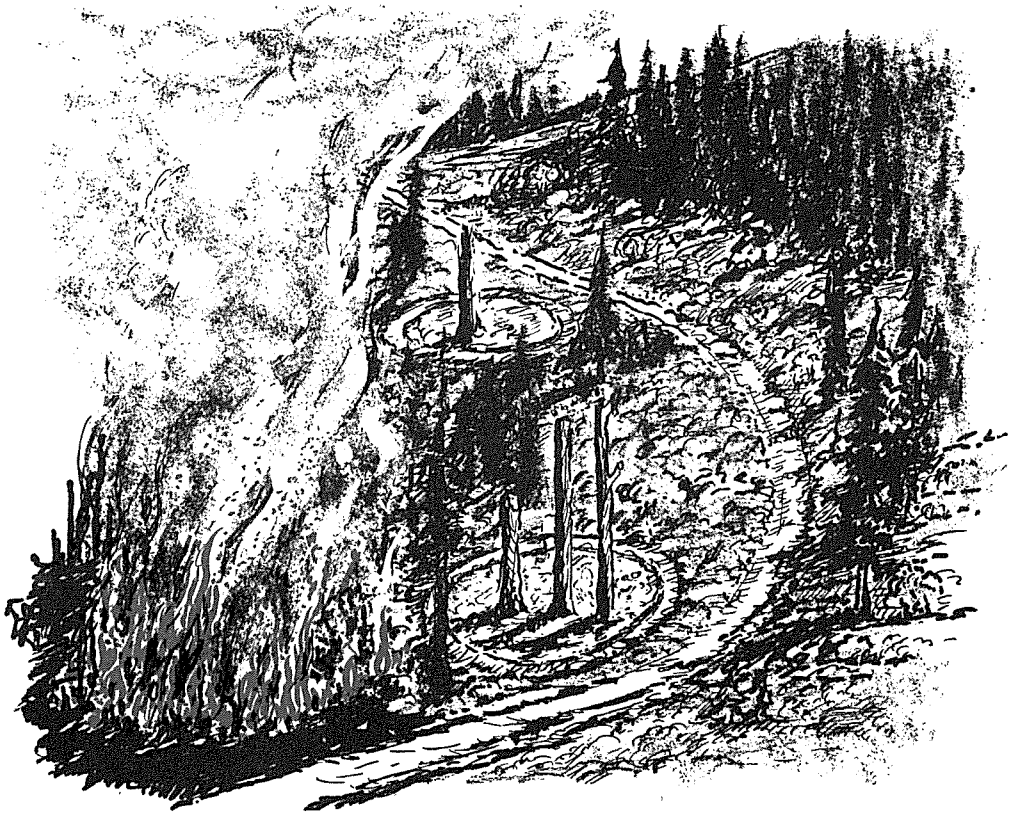


Fig. 178

Condition

Fire line could not be located to prevent leaving some snags inside the fire line. Some of the snags are close to the line, but are not burning. Danger of spotting great if snags catch fire. Time insufficient to fall snags.

Action Required

Build lines around individual snags or groups of snags and remove all fuel from base of snags. This is called "Ringing a Snag."

Why

To prevent snags from catching fire and throwing sparks outside of fire line and starting spot fires.

REVIEW QUESTIONS - LINE CONSTRUCTION

1. When should inflammable material removed during line construction be placed inside the line?
2. If placed inside, what must be guarded against?
3. What must be done to safeguard line which has been cleared too narrow to assure holding?
4. What treatment is given highly inflammable fuels outside and adjacent to fire line?
5. How do lines built above a fire differ from those built below the fire on steep slopes?
6. How is a trench built below fire on steep, rocky ground?
7. What safety hazards are involved when constructing line on steep slope in rocky country?
8. Where fire break, or other cleared strip is used as fire line, should cleared line be built on side next to fire or away from fire?
9. Under what conditions should segments of temporary line be built?
10. What work inside is ordinarily necessary as a part of line construction?
11. Why is "cold trailing" usually the correct practice during periods of high humidity?
12. What dangers must be guarded against in "cold trailing"?
13. Under what conditions or circumstances is it unnecessary to build a line? What action is necessary in such cases?
14. Name three advantages of "Hot Spotting".
15. What facts should be considered when determining the width of line necessary to hold a fire?
16. What are the disadvantages of building a line wider than necessary?

BACKFIRING

Backfiring is any intentional burning between the control line of a fire and the edge of the main fire -- regardless of the distance of the line from the fire. If the control line is near the fire, this is sometimes called clean burning, burning out, or firing out. Special problems arise in burning out between control lines and the fire.

PRINCIPLES OF BACKFIRING

1. All control lines except those at the edge of the fire must be backfired out to be effective.
2. Properly located lines simplify the backfiring problem. Backfires should be no further away from main fire than absolutely necessary to give best chance of holding the fire.
3. Where possible, start backfires on higher portion of line and burn downhill.
4. Backfire promptly, when weather conditions are favorable.
5. The best tools available should be supplied for the job of backfiring.
6. Chances must be taken in backfiring if fires are to be controlled within constructed lines.
7. In tight situations, time the setting of backfire to utilize draft from main fire.
8. Under adverse conditions, use dirt or water as aids in holding backfire.
9. Adapt backfiring practices to special topographic conditions.
10. If safety of men is assured, better to gamble on emergency backfire than to lose line to main fire.
11. Before setting backfire, see that your own and all other crews know plan and are in the clear.
12. Refer to Safety Code, Section 765.

PROBLEMS IN BACKFIRING

PROBLEM 43: HOW TO BACKFIRE WHEN FRONT OF FIRE IS APPROACHING RIDGE

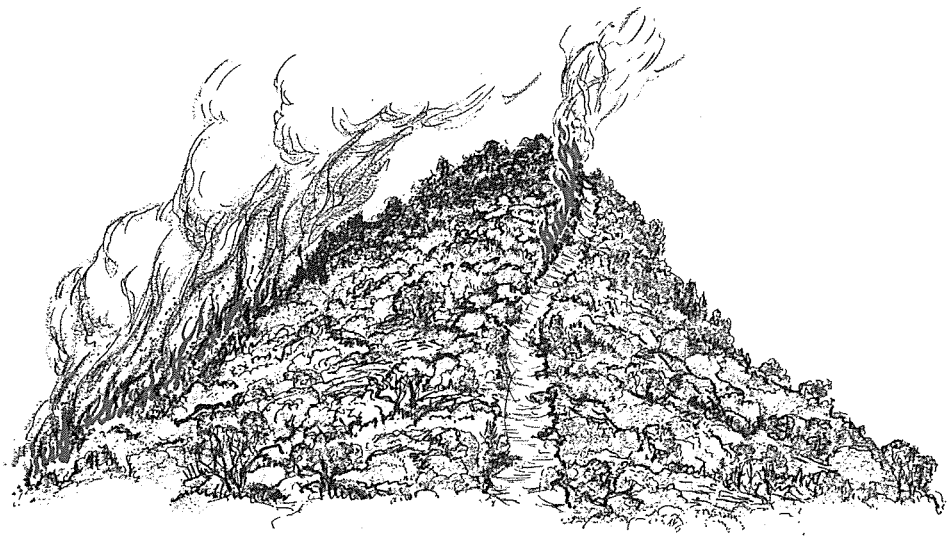


Fig. 179

Condition

Medium brush cover; wind up slope; control line is located at a distance over crest.

Action Required

Promptly set backfire along line as built, even if general wind direction is opposed.

Why

Line is properly located so that backfire can be started uphill and will burn against wind. Burn while humidity is low as indicated by active spread of main fire. As main fire nears crest, it will create an updraft which will draw backfire toward it.

PROBLEM 44: TIMING AND AGGRESSIVENESS IN BACKFIRING: IDENTIFYING AND ACTING ON FAVORABLE CONDITIONS

Condition

Fire on chaparral covered slope with uneven fire edge; burning briskly up side ridges and creeping around in canyons. Fire break on main crest; mid-afternoon wind blowing across ridge toward fire.

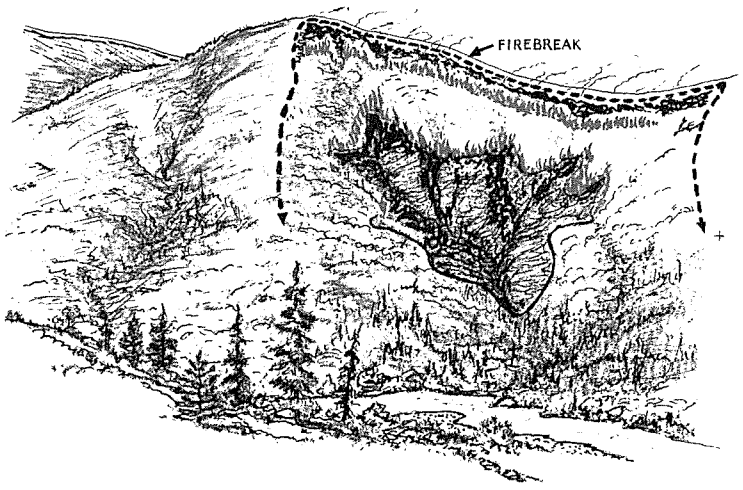


Fig. 180

Action Required

Set backfire along firebreak as promptly and as rapidly as possible.

Why

Take advantage of favorable wind and humidity condition, and push backfire aggressively to complete before wind changes, humidity increases, and fire dies down.

Supplemental Action

Same problem exists for any type or slope when line is ready to backfire and when normal outlook is that with nightfall main fire will die down leaving ragged, irregular line, difficult or unsafe to cold trail. The extent of backfiring will necessarily be determined by planned location of ultimate control lines on each flank of fire.

PROBLEM 45: HOW TO BACKFIRE UNDER ADVERSE CONDITIONS

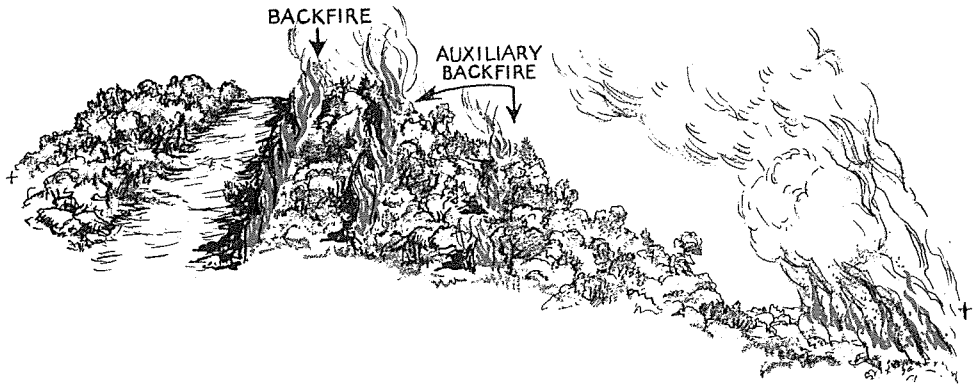


Fig. 181

Condition

Line completed at too late an hour to obtain easily a fast and clean backfire backing downhill; fire along ridge in the chaparral type.

Action Required

Stimulate backfire by use of such equipment as the flame thrower. Set auxiliary fires short distance down the slope which will burn uphill toward the line, using flame throwers if the cover is safely penetrable; otherwise use incendiary device (grenades) which can be thrown into impenetrable cover.

Why

Necessary to backfire or face blowup of fire with probable loss of line during next burning period.

Supplemental

Same situation develops because of timidity in backfiring while conditions favor ready burning.

PROBLEM 46: TIMING BACKFIRE TO UTILIZE SUCTION FROM MAIN FIRE

Fig. 182

Condition

Fire burning with a strong wind in brush or timber.

Action Required

Backfire against the wind as soon as the pull of the draft from the main fire is evident. Do not delay. Watch for spot fires. Keep safety routes or escape ways open.

Why

The fact that the onrushing fire creates a back draft in its path is extremely helpful in backfiring at close quarters. The timing of the setting of the backfire is important. The hotter the main fire, the sooner the back draft is felt.

PROBLEM 47: HOW TO USE WATER IN BACKFIRING

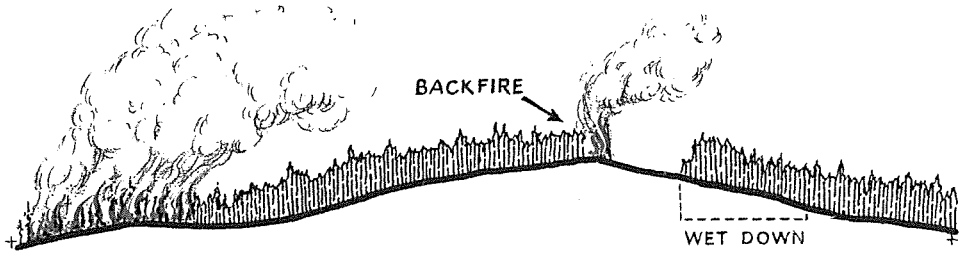


Fig. 183

Condition

Backfiring against wind; water available; brush cover or timber.

Action Required

Wet down area outside of line as backfire is set.

Why

To prevent spot fires or flaring over line.

PROBLEM 48: HOW TO USE DIRT IN BACKFIRING

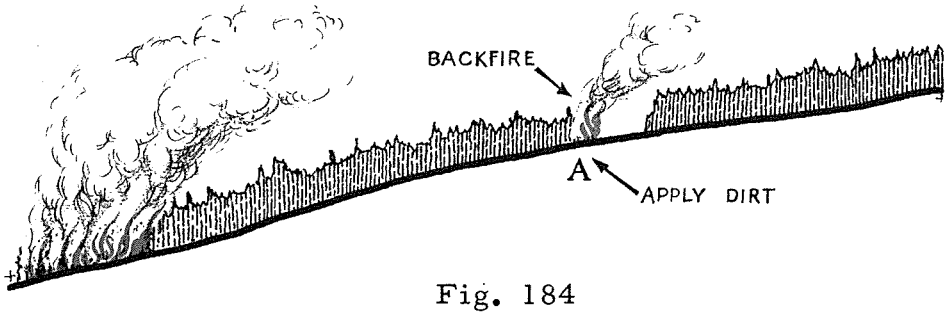


Fig. 184

Condition

Backfiring against wind from narrow line in stand of small pines or in brush.

Action Required

Use dirt or water to decrease intensity of backfire near line until backfire burns well away from line, or until draft pulls backfire in.

Why

To reduce possibility of backfire becoming too hot, driving crew out, and perhaps spotting or flaring over line.

Supp. Act. - Same problem on any line which must be backfired before line has been built to full width desirable.

PROBLEM 49: HOW TO BACKFIRE CANYON BOTTOM

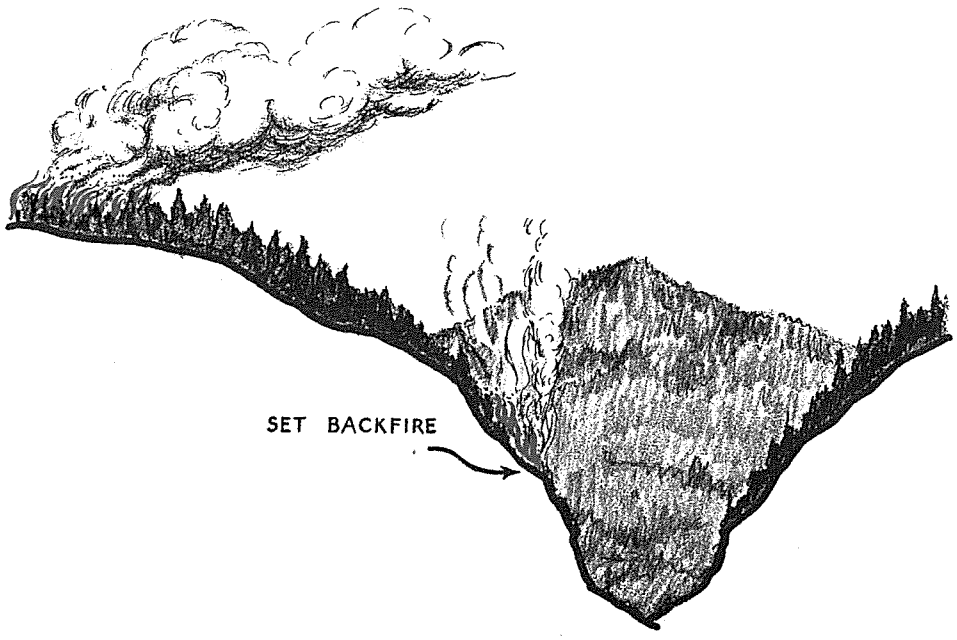


Fig. 185

Condition

Canyon bottom line, where no readily inflammable ground cover exists along the lower edge of the slope.

Action Required

Set the backfire above the barrier and up the slope in dense ground cover. It is often advisable to go up a short distance into the inflammable material, allowing the backfire to burn down as well as upward.

Why

To insure rapid and clean burn by backfire; to reduce the threat of spot fires across the canyon by allowing backfire to burn down as well as up.

Supplemental Action

Same problem exists in any area of light ground cover.

PROBLEM 50: EMERGENCY BACKFIRING OF A LINE NOT COMPLETED TO PLANNED TERMINUS

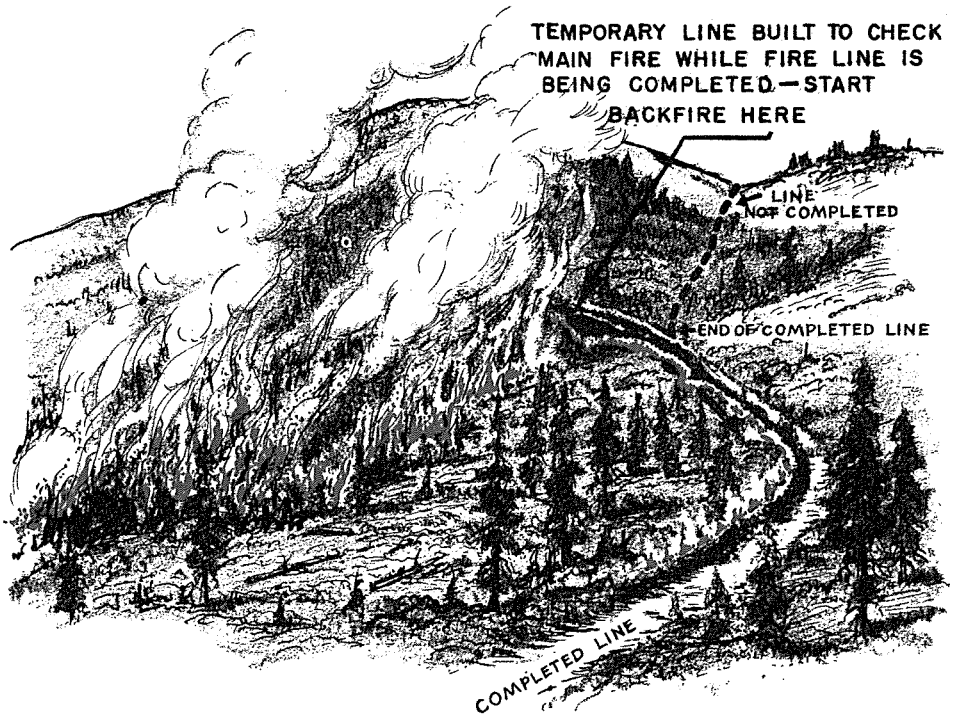

TEMPORARY LINE BUILT TO CHECK MAIN FIRE WHILE FIRE LINE IS BEING COMPLETED—START BACKFIRE HERE
LINE NOT COMPLETED
END OF COMPLETED LINE
COMPLETED LINE

Fig. 186

Condition

Line being constructed up a hill in advance of fire with plan of backfiring down as soon as line is completed. Onrushing fire does not give time enough to complete line.

Action Required

Start backfire at top of completed section of line and carry it down against onrushing fire; then complete line to planned terminus.

Why

If successful, that portion of line already built will be saved, thus narrowing down the area of spread of the fire.

Supplemental Action

Temporary line is necessary to control top edge of backfire.

PROBLEM 51: HOW TO CARRY BACKFIRE FROM TOP TO BOTTOM OF SLOPE UNDER SEVERE BURNING CONDITIONS

Fig. 187

Condition

Wind blowing up moderately steep slope, quartering to top. Rock rim at top. Fire edge farthest advanced at top; moderate rate of spread. Burning conditions favorable for backfiring. Backfire line already constructed. Cover uniform. Mixed conifer type.

Action Required

Start at top of ridge and carry backfire downhill to canyon bottom, letting one stretch of backfire burn well in toward main fire before setting next section of backfire.

Why

Limits the amount of hot line to be held at one time. Backfire does not have chance to gather headway and make a big run with attendant danger of sweeping over line. As it is gradually carried down, backfire spreads toward already burned area with no danger of getting over top of hill or over the line.

PROBLEM 52: HOW TO BACKFIRE UNDER UNUSUALLY POOR BURNING CONDITIONS

Fig. 188

Condition

Main fire has died down. Poor burning conditions. Wind gentle, downslope draft. Moderately steep slope. Mixed conifer type. Impracticable to complete control by direct attack before next burning period.

Action Required

Start backfire at a point down the line from the top and let spread uphill into the area to be burned out. Repeat by sections, moving from top to lower sections of the line.

Why

To allow the backfire to gather headway due to uphill run; to develop enough heat and draft to neutralize unfavorable burning conditions; and to obtain a good burn.

PROBLEM 53: HOW TO BACKFIRE A RIDGE LINE FIRE-BREAK JOINING TWO HIGH PEAKS WITH A DEEP SADDLE BETWEEN

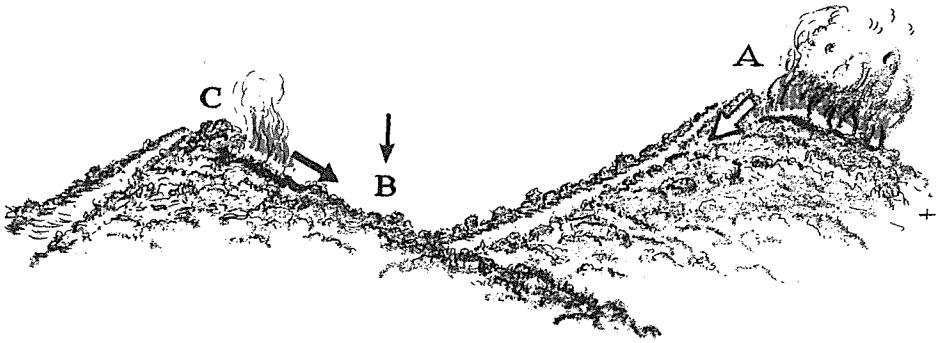


Fig. 189

Condition

Heavy brush cover. Burning conditions favorable. Wind favorable. Backfiring has reached point A.

Action Required

Continue slowly with backfiring from point A, sending part of crew to point C. Backfire from point C toward saddle, reaching saddle at B at approximately same time as backfire from A. At same time, backfire slowly to the left from C or hold the backfire at C with a check line to temporarily keep backfire from spreading past C.

Proceed very cautiously when crossing saddle since temporary adverse wind condition may be set up by backfire.

Why

If the crew had proceeded from point A to point C with the backfire, the fire might escape due to uphill run from B to C.

Supplemental Action

The same method should be used to cross deep canyons or ravines with a backfire.

REVIEW QUESTIONS - BACKFIRING

1. Why is it important that all lines be backfired or burned out?

2. How may backfiring be stimulated when conditions are unfavorable for natural spread?

3. When is it possible to take advantage of the back draft as an aid to backfiring?

4. In what way may water and dirt be used to advantage in handling backfires?

5. On steep slopes, or under severe burning conditions, should backfiring be carried from bottom to top or from top to bottom of line? Why?

6. When backfire line along ridge top dips through a saddle, what major difficulties must be guarded against?

7. When is it necessary to start the backfire so that it will burn uphill?

8. What measures are necessary to assure safety of fire-fighters when backfiring?

MOP-UP

After primary line construction work is completed and a fire is called "controlled", many things remain to be done to make the fire line "safe" and put the fire out. This work is called mop-up. The objective of mop-up is to put out all fire embers or sparks to prevent them from crossing the fire line.

A certain amount of mop-up work is done right along with line building. Mop-up becomes an independent part of fire-fighting as soon as the spread of the fire is stopped and all line has been completed. Ordinarily mop-up is composed of two actions:

1. Putting the fire out, and
2. Disposing of fuels either by burning it up to eliminate it, or by removing the fuel so it cannot burn.

PRINCIPLES OF MOP-UP

1. Start work on each portion of line just as soon as possible after line construction and backfiring are completed. Treat most threatening situations first.

2. Allow fuel to burn up if it will do so promptly and safely.

3. On small fires, all fire should be extinguished in the mop-up, where quantities of burning material are not so large as to make this obviously impracticable.

4. On large fire, completely mop-up enough of the area adjacent to the line to be certain that no fire can blow, spot, or roll over the fire line under the worst possible conditions.

5. Search for smoldering spot fires.

6. Spread well inside of lines, all smoldering material that is not put out with water or dirt.

7. Eliminate or put into safe condition all fuel of great inflammability, such as rotten logs and snags, that is outside, but near the control line.

8. Look for and dig out burning roots near control lines.

9. Separate masses of large fuel to reduce heat and danger of spotting.

10. Eliminate all snags inside of line that could, under most adverse weather conditions, throw sparks over line or fall over the line.

11. Put all rolling material into such a position it cannot possibly roll across the line.

12. Dig trenches immediately below all heavy material which might roll across the line.

13. Feel with hands for possible smoldering spots.

14. Use water wherever possible and practical in mop-up.

15. Use water sparingly, but use enough to do the job. Match the water to the job.

16. When using water to mop-up deep burning fuels such as duff or needles, scrape or stir the fuel while applying water.

17. Cut out partially burned clumps of brush or reproduction close to fire line.

PROBLEM 54: HOW TO TREAT BURNING LOGS TOO LARGE TO MOVE

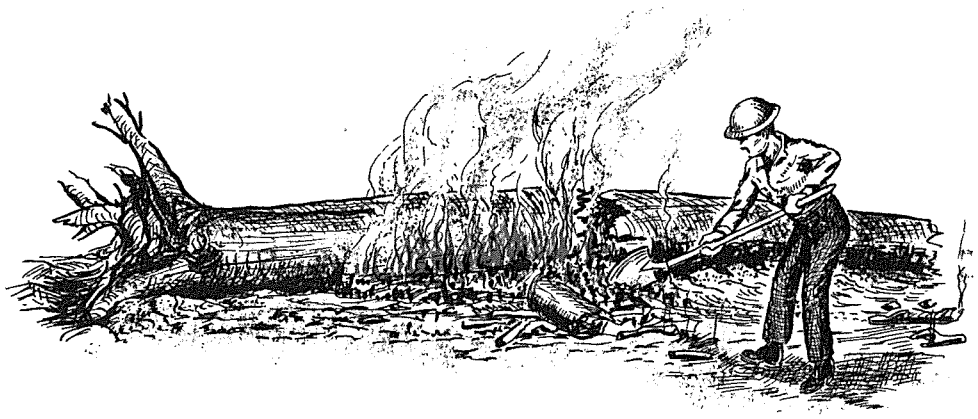


Fig. 190

Condition

Large burning log lying in a bed of hot coals and ashes.

Action Required

Remove hot coals and ashes from beneath log. Work from cool edge to avoid burning feet. Cool down with dirt or water; cover hot ground with cool earth; alternate use of dirt and scraping until log is out.

Why

Remove source of heat which keeps log burning.

Safety

Men working on logs on slopes must be alert to the possibility of the log turning or rolling. Block the log with rocks, if necessary to prevent it from rolling.

Supplemental Action

This principle applies to all mop-up work -- REMOVE SOURCE OF HEAT.

PROBLEM 55: HOW TO DISPOSE OF BURNING MATERIAL NEAR FIRE LINE

Fig. 191

Condition A

Light fuel types where burning material can be readily moved.

Action Required

Scatter fuel well back from line into burned area.

Why

To decrease possibility of spotting or blowing over by removing burning material adjacent to line and allowing it to burn up.

Condition B

Heavy fuel types with many stumps and logs too large to move. Wind blowing sparks over line.

Action Required

Cool down heavy burning material with dirt or water, then proceed with complete mop-up of individual logs and stumps as soon as they are cool enough to work.

Why

Reduce danger of spotting across line. Smother fire and reduce heat to allow for complete mop-up of heavy materials.

Supplemental Action

Burning material must not be left buried. It should be uncovered and then completely extinguished to make it safe.

PROBLEM 56: HOW TO DISPOSE OF HIGHLY HAZARDOUS FUELS OUTSIDE OF BUT ADJACENT TO FIRE LINE

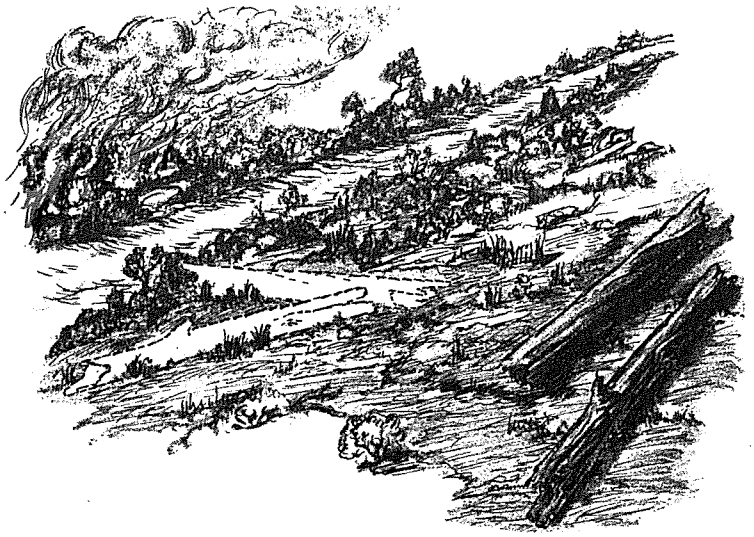


Fig. 192

Condition

Punky limbs and masses of slash just outside of hot fire line.

Action Required

Remove fuels to a safe distance from fire line. If removal is impracticable, graves should be dug and the fuels rolled into them and covered with a layer of clean earth. This is safer than attempting to cover them by fuilding up a layer of earth.

Why

To remove fuels likely to act as hosts to spot fire.

PROBLEM 57: DISPOSAL OF BURNING SNAGS

Condition A

Snag burning inside and near line with fire above reach of men.

Action Required

Scrape away all hot material from base. Cover hot ground with cool dirt or cool with water. Fall snag away from line into burn, up and down hill if lean permits. Scrape all burning material from felled snag and extinguish with dirt or water.

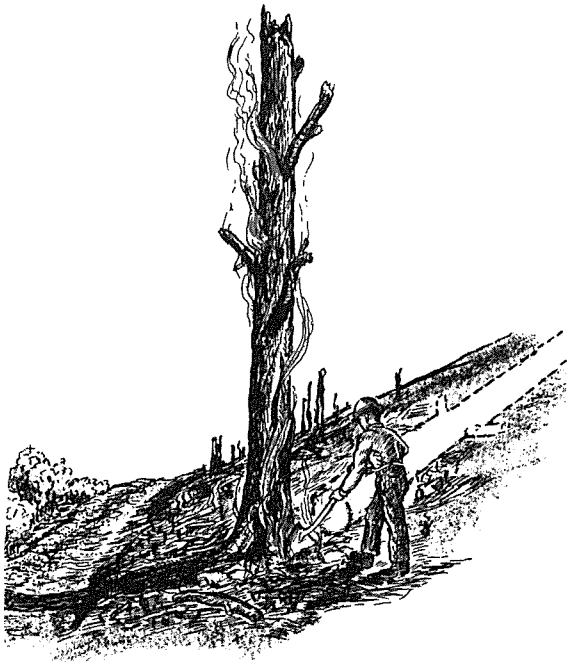


Fig. 193

Safety

Post a lookout to give fallers warning of falling tops or limbs. Plan and clean an escape route and go through a practice escape or "dry run".

Condition B

Snags burning in base only.

Action Required

Scrape away hot coals and ashes and cover hot ground with cool dirt. Knock down blaze with dirt or water; chop or scrape out burning portion with axe or shovel; peel off loose bark as high as can be reached; apply dirt or water to cracks to extinguish any sparks which might be smoldering; scatter

the material removed from snag in burned-over area. Put out with water or dirt.

Why

By removing heat from base of snag, cooling will start immediately. Snag will be safer to fall and sparks will be reduced. Men can work without burning feet.

Supplemental Action

If lean of snag does not permit falling into burn, a space must be cleared outside of burn where the snag will fall.

PROBLEM 58: HOW TO PREVENT FIRE FROM CREEPING THROUGH ROOTS UNDER FIRE LINE

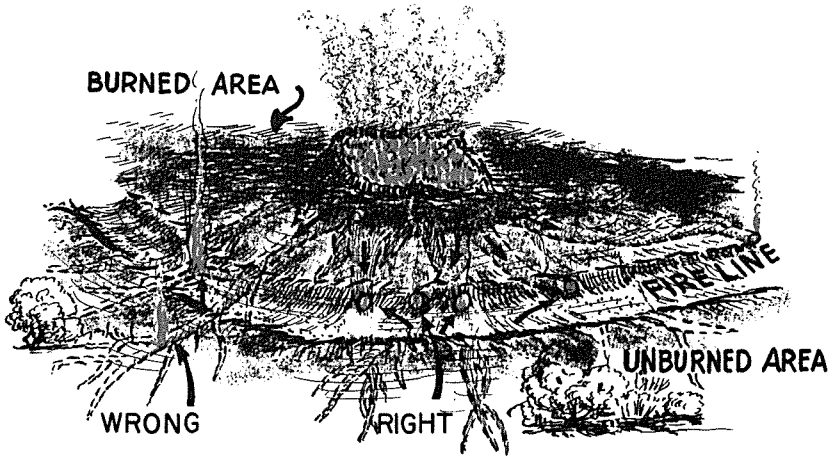


Fig. 194

Condition

Roots burning inside of and extending under fire line.

Action Required

Uncover and remove burning portions of root. Dig out and cut off roots under fire line.

Why

To prevent fire burning underground and coming up in unburned area.

PROBLEM 59: HOW TO HANDLE LOG PILES BURNING NEAR FIRE LINE

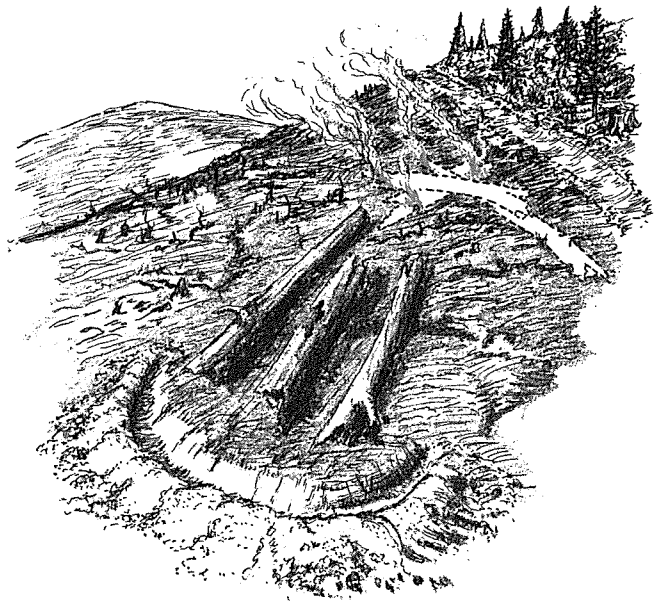


Fig. 195

Condition

Logs within spotting distance of line.

Action Required

If logs are movable, separate and let them burn out. Move to lie up and down slope and trench where necessary. Scrape off coals and use dirt alternately to put them out cold.

Why

To reduce heat and thereby decrease possibility of spotting. To prevent rolling embers when slopes are steep.

Supplemental Action

If logs won't spot over line or cannot roll, leave them in piles and burn them up. This eliminates the hazard and reduces the mop-up job.

PROBLEM 60: HOW TO PLACE MOVABLE, BURNING LOG SO IT WILL NOT ROLL

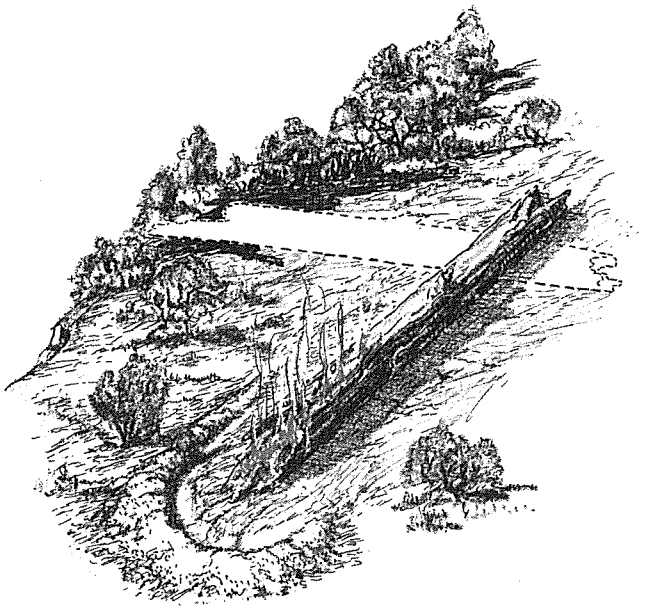


Fig. 196

Condition

Burning log lying on contour of slope.

Action Required

Move log to lie up and down slope. Trench around lower end to catch rolling embers.

Why

To prevent logs and live embers rolling into unburned territory.

Supplemental Action

If a log is too large to handle, cut to sizes that can be moved and proceed as above. If log is too hot or too large to cut, block with rock or earth and trench along lower side of log to catch rolling embers and the log itself.

PROBLEM 61: HOW TO HANDLE BURNING STUMPS

Fig. 197

Condition

A fire on a steep slope has burning stumps that should be allowed to burn up, but which may result in live embers rolling over the undercut fire line on the lower edge of the fire.

Action Required

Construct a trench close to and on the downhill side of the stump, to catch the burning embers.

Why

To prevent burning embers from rolling and possibly going over trenched fire line. Placing the trench close to the stump makes it more effective.

PROBLEM 62: HOW TO DISPOSE OF BURNING CHUNKS, LIMBS, AND SMALL LOGS

Condition A

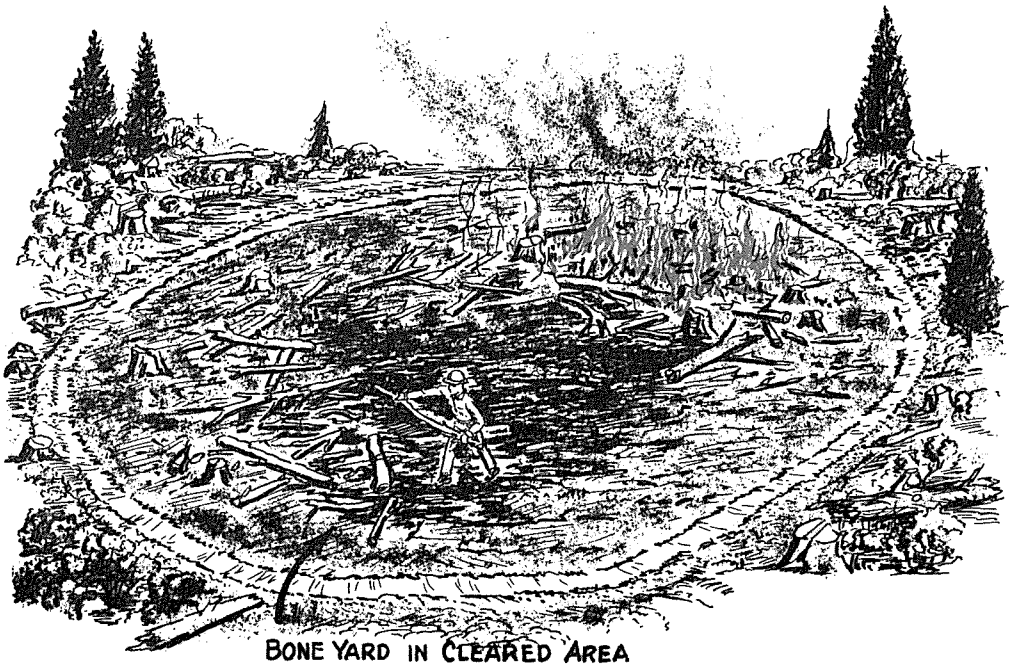
Many burning chunks, limbs, and small logs on moderate or steep slope; may roll over trenched line.

Action Required

Construct trenches along slope in burn long enough to hold all chunks. Place chunks in trenches. Let them burn up. Don't bury them.

Why

To allow chunks to burn out without danger of rolling over lower fire line.



BONE YARD IN CLEARED AREA

Fig. 198

Condition B - Boneyarding

Small fire in cut over timber. Many limbs, chunks, and small logs; not all burning.

Action Required

Systematically work the entire fire area using dirt to cool. Scrape off hot coals. Then pick up the limbs and feel with hands. If material is out cold, pile in burned area in a spot cleared of all burning or hot fuels. This is called "Boneyarding".

Why

Results in thorough mop-up with little chance of material again catching fire.

Safety

Feel carefully. Use back of hand to test limbs which may be hot.

Supplemental Action

Same system may be used to mop-up area adjacent to line on a larger fire.

PROBLEM 63: HOW TO USE THE HANDS IN MOP-UP

Condition

A severe fire has burned over a small area that contained a fairly heavy stand of timber with considerable duff, a few patches of brush, and some rotten logs. The fire appears to be out and no smoke can be seen.

Action Required

Test all of the burned area with bare hands; feel particularly in partly consumed duff, in incompletely burned litter, and into the remains of punky logs. Dig out hot spots as discovered, and extinguish with dirt or water.

Why

To locate smoldering fire which cannot be seen. Prevent rekindling of partially burned material.

Safety Precaution

Feel carefully for hot material. Use back of hand to test above piles of white ashes. Back of hand is more sensitive to heat. Severe burns may result from lack of caution in "feeling out".

PROBLEM 64: HOW TO USE WATER EFFECTIVELY IN MOP-UP

Condition

Fire has burned up steep slope with vertical rise of 1,000 feet; truck trail on crest of ridge; lower fire line parallels a small stream. A tank truck, backpack outfits, portable pump, and hose available. Unsafe to leave fuels to burn up.

Action Required

Assign crew to mop-up bottom portion of fire with portable pump near stream. Tank truck crew operates from truck trail and works down from top. Backpack crew works in area not covered by portable pump and tanker. Hand tool men working with nozzle men enter and go over area methodically, turning all chunks and small logs, and applying water with spray. Also stir or spade and turn all duff while spray is applied. This procedure should be repeated until all fire is extinguished.

If accumulations of heavy fuels are burning close to control line, they should be cooled down first to reduce danger of loss of line.

Why

If properly and skillfully applied, water will speed up the job of mop-up. Water can reduce cost of patrol and relieve men sooner for other fire duty.

Supplemental Action

Small fires can best be suppressed by applying this principle to the whole area (rather than just around the perimeter as stated for a large fire). Water alone cannot do the job. To be effective, hand tool work turning hot material to let the water get to the fire is absolutely necessary. Drowned fires should be checked repeatedly for sparks which have been overlooked in the mopped-up area.

PROBLEM 65: HOW TO MAKE SAFE PARTIALLY BURNED CLUMPS OF BRUSH OR REPRODUCTION CLOSE TO THE FIRE LINE

Condition

A backfire ran through brush or reproduction close to the line, but has merely dried it out without consuming the crowns.

Action Required

To eliminate the threat before the heat of the next day.

1. If the amount is not too large, cut down and scatter away from the control line inside the burn in areas free from fire.

2. If no danger of spotting across line, use special firing equipment such as torches and flame throwers, to burn out scorched crowns.

3. If the patches are too large to handle by methods 1 or 2, put out all surface fire within them and construct a good line between them and the rest of the fire.

Why

To either remove fuel or isolate from possible ignition next day. Scorched crowns of brush or reproduction are particularly dangerous fuels. They ignite readily during heat of day and fire will flash through the crowns over previously burned ground. The danger of spotting and flaring over adjacent lines is extreme.

PROBLEM 66: LINE AROUND FIRE, BUT UNBURNED MATERIAL BETWEEN LINE AND RAGGED EDGE OF FIRE

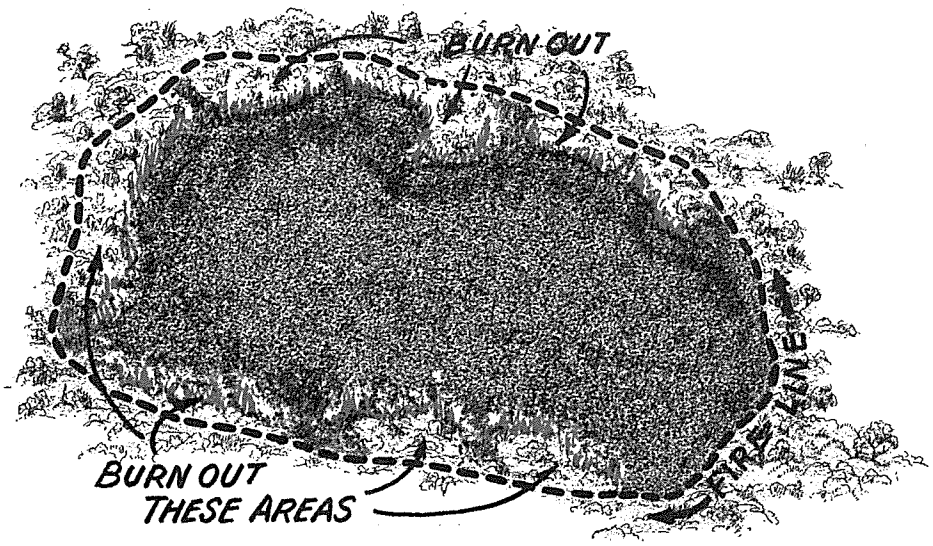


Fig. 199

Condition

Fire burned with ragged edge and many fingers. Fire line cuts across the tips of the fingers, leaving unburned material between fire line and ragged edge of fire.

Action Required

Burn out the material between fire line and fire edge, preferably by burning back from the fire line.

Why

To remove the danger of the fire flaring or spotting across line sometime later when burning conditions might be worse, or when no one is near by.

Supplemental Action

A fire is never controlled until burned clean back from the fire line. Where clean burning is impracticable, as it is sometimes in brush types, fuel should be cut and removed.

PROBLEM 67: UNBURNED ISLANDS IN A SMALL FIRE, WITH COVER HEAVY ENOUGH TO THROW SPOT FIRES

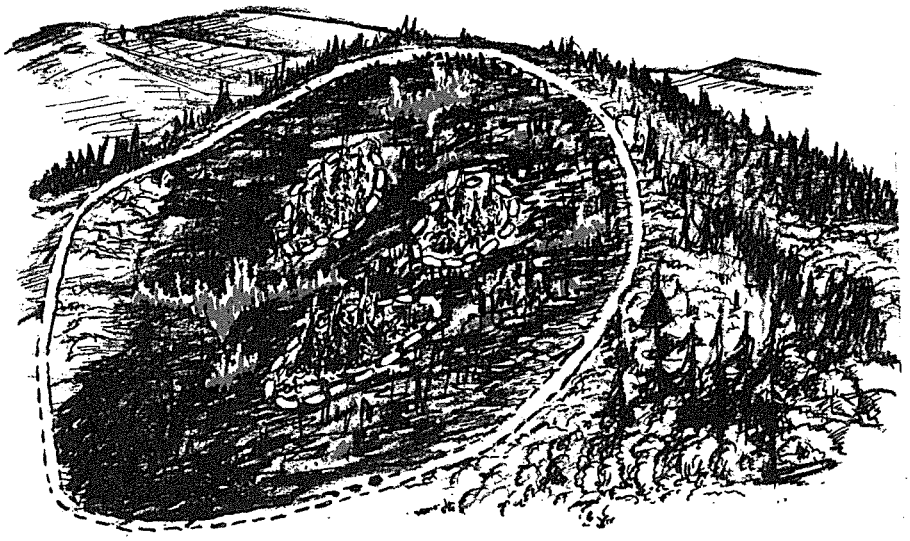


Fig. 200

Condition

Fire did not burn hot enough to get a clean burn and several small islands of singed brush remain within the final control line.

Action Required

Build continuous control line around the outside of each island to keep them from burning later. If they consist of small patches of singed reproduction or brush close to the outside control line, cut the brush and reproduction down, if this can be done with a reasonable amount of effort. Check island carefully for hot spots.

Why

To remove the possibility of the fire later moving into the unburned or incompletely burned areas and spotting over the control line. To make a barrier down to mineral earth around all burned areas.

PROBLEM 68: HOW TO HANDLE SPIKE-TOPPED TREE OR TALL SNAG SHOWING SIGNS OF FIRE WITHIN FIRE LINE

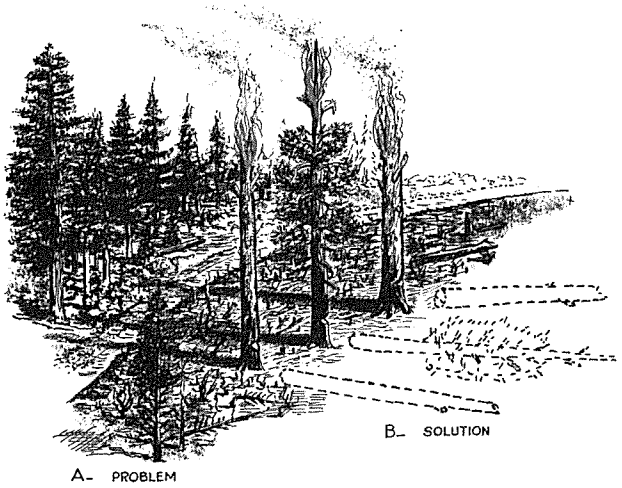


Fig. 201

Condition

Several snags and a spike-top (dead-topped tree) are located within the fire line and have smoke or fire showing in their tops. No sparks are falling or blowing over the line at the present time.

Action Required

The spike-topped tree and the snags should be felled away from the fire line and all burning material cut out and removed from main portion of the tree.

Why

To eliminate the danger of spot fires from sparks which may blow across the line because of a change in wind direction or velocity.

Supplemental Action

Any dead-topped tree or snag which has been subjected to hot fire is likely to hold fire, and is potentially dangerous; any trees of this type near enough to fire line to throw sparks across line in high wind, should be felled, examined carefully, and extinguished if they are found to have any fire.

PROBLEM 69: HOW TO CONTROL SMALL SPOT FIRE OUTSIDE THE FIRE LINE

Fig. 202

Condition

Small spot fire has been found at considerable distance outside fire line.

Action Required

Take immediate action to control the spot fire. Construct substantial cold trail around the spot fire and if possible, put it completely out.

Why

To prevent spread of the spot fire, thus saving work already accomplished on main fire line.

Supplemental Action

A trail should be cut from spot fire back to main fire line and sign posted there to call attention to existence of the spot, so it will be checked again later. This sign can be just a sheet out of your notebook saying "Spot Fire 50 feet west".

PATROL

Patrol is a necessary part of the fire suppression job. However, due to a misunderstanding of the term "Patrol", many man-days have been wasted walking the fire line without producing any real work.

Except for certain situations listed below, patrol work is a part of the mop-up job. Patrol is that portion of the mop-up job which consists of moving back and forth over control line and edge of burn to check for and put out dangerous fire that may burn or blow across the line and at the same time check for and put out any spot fires outside the line.

Men are sometimes assigned to patrol for observation purposes with instructions to take prompt action on dangerous situations. Such patrol assignments may be made in the following situations:

1. Immediately after setting a backfire -- to check for and suppress spot fires.
2. Watch for spot fires near the line adjacent to hot, dangerous snags which cannot be felled.
3. On undercut line where rolling embers are likely to cross trenches.
4. Guard against breaks where heavy fuel such as snags, stumps, or log piles are being burned out.
5. Be on the watch for spot fires in spark-strewn areas outside the line.
6. Search for smokes during the later stages of mop-up and for a period after mop-up appears to be complete. Small smokes are generally most easily seen when looking toward the sun.
7. Provide detection along line where incendiarism is suspected or likely.

THINGS TO DO IN ORGANIZING PATROL

1. Designate definite area for each man.
2. Arrange for communication or signal between patrolman and crew.

3. Have patrolman work on dangerous spots as well as watch them.
4. Designate special danger points to watch.
5. Systematize patrols so men do not get together for "gab fests".

REVIEW QUESTIONS - MOP-UP AND PATROL

1. What is meant by "mop-up" ?

2. What treatment is given to heavy concentrations of smoldering fuels adjacent to and inside the fire line?

3. What is done to prevent fire from creeping under line in punky roots?

4. When fire in snag is close to line and above reach of fireman, what should be done? If snag leans toward burn? If snag leans out over fire line?

5. What is done with heavy masses of hot fuels burning close inside the line?

6. How may a log, burning too hot to be immediately extinguished, be made safe on steep ground?

7. What may be done to safeguard stumps burning on steep ground which has been left to burn out?

8. What should be done with scorched brush and trees close to and inside fire line?

9. Name three ways in which dirt may be used in mop-up.

10. What precaution must be taken in "feeling-out"?

11. What principles of water application apply to most mop-up jobs?

12. How are isolated, controlled spot fires identified and found by follow-up crews?

13. What is meant by the term "patrol"?

ABANDONING FIRE

Things to be checked by Fire Boss before abandoning fires:

A. Inside the fire line. Within threatening distance of a line, check that --

1. All snags and spike tops have been felled.

2. Logs and chunks are --

   a. Burned up;
   b. Completely put out and surrounded by safe line;
   c. Lying up and down slope; or blocked with rocks so they can't roll; or
   d. Trenched immediately below if on steep ground.

3. All stumps --

   a. Burned up;
   b. Fire completely out; and
   c. Checked if near fire line to be sure no roots cross the line.

4. All unburned patches of fuel --

   a. Surrounded by safe line or cold trailed;
   b. Burned out; or
   c. Cut down and scattered.

5. All brush and reproduction with scorched dry crown --

   a. Cut down and scattered; or
   b. Burned out with torch.

6. All smoldering litter, duff, or rotten wood scattered and burned up.

B. The fire line. Check that --

1. Continuous, clean line is built to mineral soil.

a. No roots at or near surface;
b. No stringers of rotten wood or duff;
c. No stringers of needles or leaves kicked across line.

2. No burning or smoldering material is left along fire edge.

3. No unburned patches left next to the line.

4. Undercut lines on steep slopes are trenched.

C. Outside fire line. Check that --

1. Ground has been covered and inspected systematically in areas surrounding fire. Be positive that:

a. Smoldering spot fires in rotten logs, stumps, and base of snags are out;
b. Smoldering spots in piles of old bark are out!
c. Snags and spike tops with smoldering spots are felled and put out;
d. Smoldering limbs and knot holes are cut off and put out;
e. Material that might have rolled across lines during control is put out.

2. Area near line has been checked for surface roots which may come from stumps burned just inside fire. Any such roots found must be chopped out.

3. Spot fires have been completely extinguished.

4. Lava cracks or rock fissures have been followed up and checked to be sure any duff or other fuel is out.

SUPPRESSION OF CREW-SIZED AND LARGER FIRES

Each of the preceding problems has illustrated one or more of the important steps that are taken to suppress fires. In the problems that follow many of these steps are taken in logical order by a suppression crew.

PROBLEM 70: SUPPRESSION OF A 1-ACRE FIRE

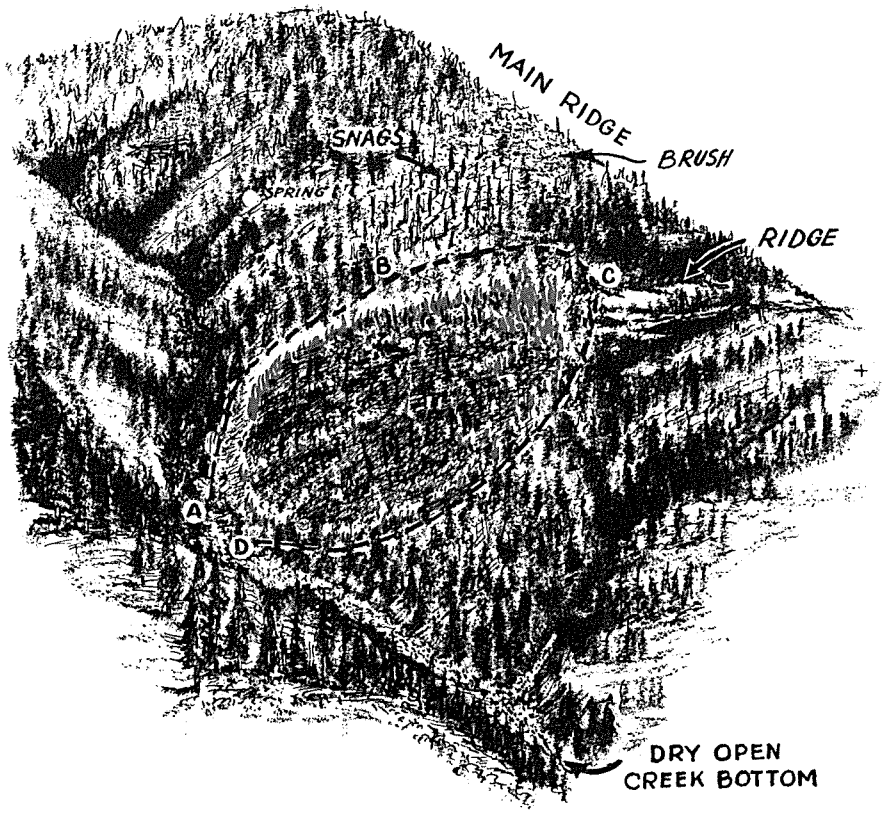


Fig. 203

Condition

Fire is reported to a foreman of a 5-man suppression crew at 1500. He took crew and left at once in tank truck; on arrival found fire burning briskly in an open pine stand on a moderately steep slope. Fire was about an acre in size. From the lookout's report, fire was known to be a lightning strike. The men had to walk in half a mile from the road to the fire. They took tools, including a falling outfit, McLeods, shovels, axes, fusees, canteens, headlights, hard hats, portable radio, and rations for two meals.

Action

1. Having sized up the general topography, cover, and weather conditions on way in, foreman found on arrival that fire had backed down into a dry creek bed and was threatening a side canyon (line A-B of sketch). He reported conditions to Dispatcher by radio.

2. He assigned three men, two with McLeod tools, one with shovel and axe, to make a direct attack starting at the lower edge of fire from creek bed up left flank (line A-B) instructing them to hot-spot the line and prevent the fire from crossing the side canyon.

3. He took one man who had a McLeod tool and started scouting along the right flank of the fire (line D-C). He carried an axe and a shovel. On reaching the top of ridge he found that the head of the fire was over a small spur ridge. Just beyond was a group of snags. Not far beyond was a dense brush patch.

4. He started the McLeod man to work constructing a line to mineral soil between the snags and on-coming fire, indicating where line should go (line B-C), instructing him to keep a careful watch for spot fires.

5. Going back to top of spur ridge at B, he called down for two men to come at once and help construct the line to cut off head of fire. He instructed remaining one man

to continue hot-spotting the left flank of fire (line A-B), and to maintain a careful watch of conditions along the line to see that fire did not flare up and cross line behind him.

6. He then helped the three men complete a control line across and in front of head of fire (line B-C) and down right flank for a short distance on line C-D. This line was backfired as soon as constructed, beginning just below spur-ridge (near C), and continuing around to meet the one man on line A-B who by this time had reached the spur ridge at "B".

7. The foreman had been watching all of the time for spots over the line, but since the run of the fire was not fast and the fuel type had not created sparks, he found none.

8. After the backfire had burned back to meet the main fire and started to cool down, he left one shovel man to patrol and improve the line A-B-C.

9. He selected and marked location of line down right flank of fire (line C-D) to tie in to creek bed at lower edge of fire (D).

10. He used three men to construct this line, backfiring it downhill as line was built. He maintained a careful watch for spot fires over the line as firing progressed down the hill.

11. When burning out was completed, he left one man with shovel to mop-up this line and watch for spot fires.

12. After starting the other two men to cold trailing and improving the line A-B, he set up the radio and reported to Dispatcher that fire had a line around it, mop-up work started, and control was assured in the absence of some unexpected change. He asked that 2 dependable men be sent to fire to relieve his crew during the night since there was considerable mop-up work to be done.

13. After checking area ahead of fire, well outside of the line for spot fires, he then scouted inside of burn for snags and trees with fire in them. He found only one snag on fire in center of burn. Snag was not throwing sparks at the moment, but must be felled.

14. Returning to line A-B, he found the two men had completed the cold trail. As these two men had been hitting the ball hard, he had them take a rest at a location near point B where they could watch the line, while he scouted for and found a spring in a side canyon as shown on his map. He marked a trail leading to it so that water could be obtained for mop-up of fire.

15. Returning to the fire, he instructed the two mop-up men to continue with the mop-up inside the line. After again checking area outside of line and well ahead of fire, he returned to line A-B where two men were resting.

16. Taking these two men and falling outfit he proceeded to the snag to be felled. After sizing up the situation and deciding on a safe plan of action, he had the men go through a dry-run of safety precautions including escape route. He alternated with the men in falling the snag. Two men sawed while one man acted as lookout for falling limbs, burning embers, and other hazards.

17. With the snag down, the two men were sent to the truck to bring in two backpack pumps and sleeping bags for all men.

18. He then checked progress of mop-up work being done by other two men. He saw that all weak line had been or was being strengthened, all logs that might roll were turned up slope, burning materials were being scattered well inside the burn, no sharp angles or turns left in lines, and all material close to the lines were burned clean, except for a few isolated logs.

19. With the arrival of the two men with packpack pumps, mop-up work was speeded up. Since the area was small, the crew eventually covered the entire area, mopping up with water and dirt.

20. He took one more trip ahead of the fire, making a careful check for spot fires well outside of line, checking control line carefully and found all line in good condition.

21. About 1900, since all was quiet, he took entire crew back to open creek bed (line A-D) where overnight camp was made. All crew men ate and went to bed. The two fresh men sent out to patrol fire during the night arrived.

22. The foreman took the night men around entire fire, pointing out mop-up work to be done, dangerous spots to watchl carefully, and areas to check for spot fires. He instructed them to awaken crew should conditions warrant. The foreman then joined the crew in camp for the night.

23. At 0400 the men were awakened and ate breakfast. By 0430 mop-up work was resumed. Foreman worked with the men, in turn making sure that each man understood how to check logs and other partially burned material for live fire and how to treat each case and why. As the day advanced:

24. He made careful checks of all country near, but outside of the lines for spot fires.

25. He went over control lines, foot by foot, to be sure no roots crossed line from burn to outside.

26. He inspected the tops of all trees to see that no punky places were afire.

27. He inspected all undercut lines to see that trenching was adequate.

28. He maintained periodic radio checks with Dispatcher throughout the day in case he might be needed on another fire.

29. He made a paced survey of the fire and recorded the data needed for the Form 929 Fire Report, by filling out Fireman's Report (See Appendix 7, Form 144-R5, Fireman's

Report). This included the times of the principle steps in suppression, damage to timber, cover type, and other information.

30. No live fire was found after 1400, so at 1900, after making a final inspection of all key points, the crew left the fire as out. They marked the trail back to the road to aid the Fire Control Assistant in locating the fire for his final inspection the following day.

SUMMARY OF CORRECT PRACTICES USED

1. Fire was scouted.
2. Attack was directed to proper key points.
3. Lines were located and did not just grow.
4. Lines were burned clean as built.
5. Lines were patrolled after completion.
6. Lines were mopped up promptly.
7. Snags were felled promptly.
8. Water and dirt were used freely in mop-up.
9. Radio was used.
10. Food and water provided for.
11. Spot fires were searched for.
12. Natural barriers used.
13. Crew men trained in proper methods of mop-up when possible.

PROBLEM 71: BACKFIRING A SECTION OF FIRE LINE WITH A SMALL CREW

Condition

Backfire line already constructed. Size of crew: 10 men. Equipment: two backfiring torches or flame throwers, shovels, axes, extra fuel, lunches, and canteens. Time: early evening, mid-season. Burning conditions moderately favorable; humidity 30; up-canyon draft gentle. Mixture of mature pine and fir trees with normal litter and some brush.

Action Required

1. Crew Boss takes crew to highest point on line.

2. Assigns one shovel man and one axe man to scout ahead of torch men along line to be fired. He instructs these men to examine the area along and adjacent to the inside of the line and clear around snags, logs, and dense cover which will create dangerous situations if ignited by the backfires -- the shovel man is instructed to cover dangerous stumps and log ends outside the line with dirt.

3. Assigns two men to firing after instructing them on how to light torches or flame throwers, and how to ignite fuel. Starts them firing from high point down, instructing them how far to proceed before stopping for further instructions. Also tells men to burn out around the cleared snags, logs, and stumps before firing the main line. (Fire will then burn away from these critical fuels instead of toward them.

4. He assigns 5 shovel men and 1 axe man to follow the torch men, assigning one of these men as a Straw Boss.

5. He instructs Straw Boss to follow backfiring as it proceeds and to assign each shovel man a designated section of the backfired line to protect against spotting or flare-over. Instructs them how to take care of such situations by cooling the hot spots and flare-ups with dirt, and how to put fire lines around all spot fires. Instructs men how to give the alarm if there is a break.

6. He goes back and forth constantly along the backfired sections of line, inspecting with the Straw Boss the work of the shovel men. In order not to delay backfiring, sees that only work necessary to hold fire is done, leaving complete mop-up until later. Moves men forward to freshly fired sections as soon as their sections have cooled down. That way only occasional patrol is necessary.

7. Regulates the speed of the torch men so that no more line is fired than can be adequately patrolled by shovel men.

8. Continues the backfiring by stages until entire backfiring assignment is completed.

9. Drops off additional patrolmen as needed to safeguard line.

Supplemental Action

1. It is the Crew Boss' responsibility to get as complete a burn as possible. When fired stretches go out or burn in patches, he must have shovel men pile and ignite dry material to get fire started. Or he may set a second backfire farther inside the line in readily ignited material. Use flame thrower in locations difficult to backfire.

2. Time is critically important. Keep men working at the speed necessary to complete the entire firing job before burning conditions become too poor for ready ignition and burning. In early morning backfiring, speed is essential to complete the job in time to allow the line to cool down to point of safety before the wind and temperature rise and the humidity drops, bringing dangerous burning conditions.

3. Make it a rule that men remain on their assigned units of line when eating lunches, so as to leave no line unattended. Water should be distributed to men when initial supply is used up.

4. In situations where humidity rises so that backfiring will no longer take hold, the Crew Boss should report progress and conditions to the Sector Boss. Subsequent action of the Crew Boss will be based on the decision of the Sector Boss.

PROBLEM 72: MOPPING UP A HILLSIDE LINE ON A LARGE FIRE

Condition

Crew Boss with 20 men and 4 Straw Bosses have been assigned to mop up one-half of hillside line on a large fire. There are about ten snags to fell inside fire line, varying from 20 inches to 48 inches in diameter; many stumps to trench; several logs which can be moved and a few large logs burning near the fire line; much small stuff burning along fire line; several patches of scorched manzanita along edge of fire; several burning stumps that can be put out with water; and a few stumps adjacent to outside of line opposite hot stuff inside. Time: 0400. Required to make safe before burning period (1000) and thoroughly mopped up by evening. Men are equipped with proper tools, including hard hats.

Action

1. Crew Boss assigns three men, each equipped with axe and shovel and with one back pump for the unit, to dangerous points along line. Established definite patrol sections for each man. Instructs men to check constantly along the edge of the fire both inside and outside, and to do emergency mop-up work at most dangerous points to hold fire in check until arrival of the main forces.

2. Organizes 14 men for working as 3 units on mop-up. Equips each man with shovel; also two Pulaskis and a backpack pump in each unit. Places a Straw Boss in charge of each unit and instructs them to work their units along the fire edge both inside and outside, taking care of the most dangerous material next to the line on the first trip through. On the return trip they will thoroughly mop-up to the desired distance from fire edge. Also instructs Straw Bosses to:

    a. Trench burning stumps, taking care of most dangerous ones first and cutting off burning roots extending toward line.

b. Turn logs to prevent rolling, trench and block large logs, and move or separate log piles.

3. Organizes falling crew of three men with one of the men as Straw Boss, equipped with felling tools and a shovel. One man will watch for falling limbs and chunks while the other two fall snags. Shovel to be used for cooling down base of snags. Starts crew on snags which are the worst fire hazards first, if they can be handled safely.

4. After Crew Boss has organized the crews and set them to work on the ground, he constantly works between units to supervise and inspect their work, and he changes the plans as the emergency of the situation demands.

5. When any unit completes its assignment, he reassigns men to other duties.

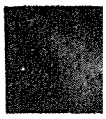
SUMMARY OF CORRECT PRACTICES USED

To identify specific dangers and to see that they are eliminated is the contiuing job of the Crew Boss. These duties usually include:

1. Carrying mop-up far enough inside fire.
2. Preventing possible roll across line of material such as logs, chunks, and yucca plants.
3. Hastening burning out of duff and heavy fuels.
4. Extinguishing with water and dirt.
5. Removing scorched brush or reproduction from edge of fire.
6. Covering up punky logs and stumps outside line.
7. Disposing of snags.
8. Watching for spots and burning snags outside line.
9. Feeling for hot stuff before assuming that any given part of fire is out.
10. Cutting off burning roots that extend toward line.
11. Instructing crew in safe working practices.

CHAPTER VII

ORGANIZING FOR FIRE SUPPRESSION



ORGANIZING FOR FIRE SUPPRESSION

ORGANIZATION FOR VARIOUS SIZED FIRES

ONE MAN FIRE

When one man attacks a small fire he is the Fire Boss. He has three tasks to do.

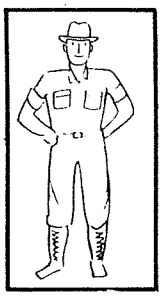
1. He must get to the fire with the right tools to do the job. This is the Service phase of the job.
2. He must size up the fire and decide what to do. This is the Planning phase of the job.
3. He must put a line around the fire and put it out. This is the doing phase of the job or the Line Job.

Fire Boss

SMALL SUPPRESSION CREW FIRE

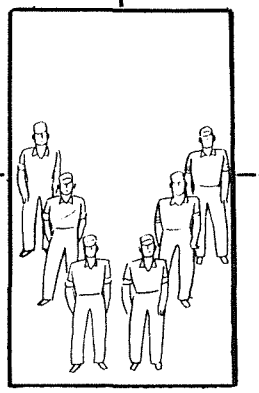
When a crew is sent to a larger fire, one man, the crew foreman is the Fire Boss.

1. He must see that the right tools and equipment get to the fire. (Service)
2. He must size up the job and decide what his crew should do. (Plan)
3. He must see that his crew puts a line around the fire to control it. (Line Job)



Fire Boss

or, a tractor-plow unit, one operator and 2 to 3 men



or, a tanker, one operator and 2 to 3 men

WORKERS

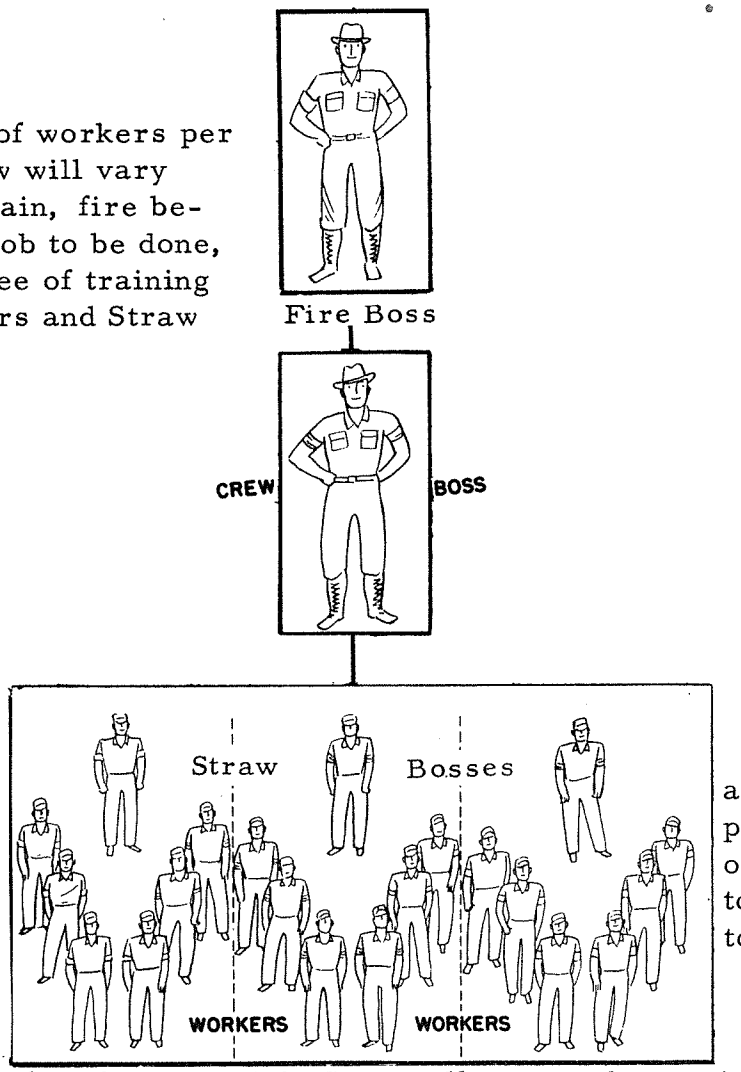
SMALL SUPPRESSION CREW FIRE

Fig. 204

LARGE CREW FIRES

When more men are sent to a larger fire, the District Ranger or Assistant will probably go to the fire to coordinate the workers and be the Fire Boss.

Number of workers per Sub-Crew will vary with terrain, fire behavior, job to be done, and degree of training of workers and Straw Bosses.



or a tanker, one operator and 2 or 3 men, or a tractor-plow unit, one operator and 3 to 5 men.

Number of workers per Sub-Crew will vary with terrain, fire behavior, job to be done and degree of training of workers and straw bosses.

Fig. 205

Tractor-dozer, tractor-plow or tanker units may be substituted, in part for the workers. When this is done a special Equipment Boss will replace the Crew Boss; also Operators for the equipment will be required.

MULTIPLE CREW FIRES

More crews must be sent to the larger fires, but one man, the Fire Boss, is still in charge. He may be the District Ranger or his Assistant and may have to call on many men to help with the job of putting out the fire.

1. He may require help from the Dispatcher, cook, truck drivers and others to get the right tools, equipment, machines and other supplies to the line. (Service)
2. He may have a scout helping in the size-up to plan and decide what must be done. (Plan)
3. He may order many crews to control the fire. (Line Job)

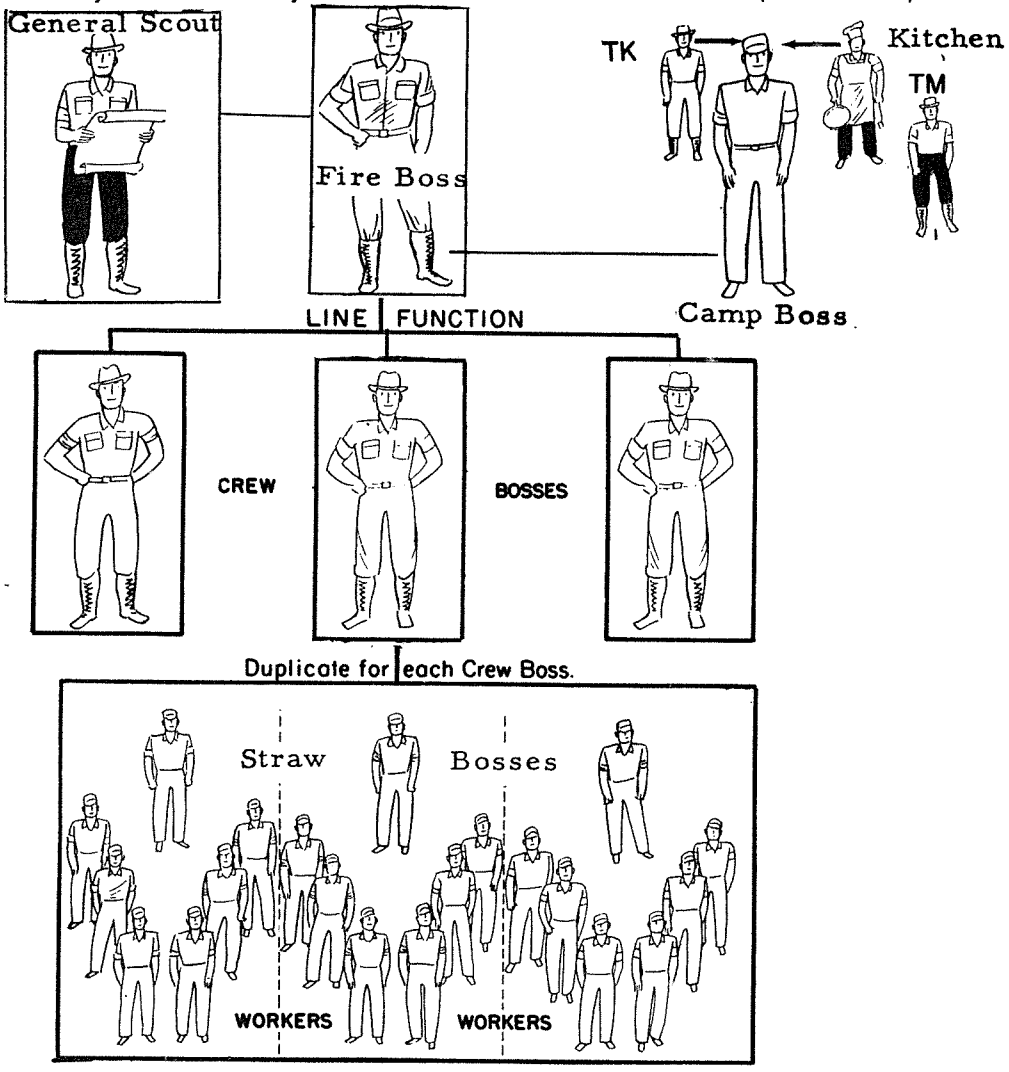


Fig. 206

ORGANIZATION FOR VERY LARGE FIRES

Fundamentally controlling a large fire is the same as controlling a small one. One man, the Fire Boss, is in charge of the whole job, but it takes many men and more machines to do the job.

The differences are that on large fires

1. The service job -- getting the men, the right equipment and supplies to the fire -- is handled by specialists.
2. The planning job -- sizing up the fire and deciding what to do -- requires specialists who have no duties in actually building the line.
3. The line job -- building line and putting out the fire -- is systematically divided among a number of people.

The chart below shows you how the line job, planning job and service job are divided among the many men it takes to do the entire job of putting out a large fire.

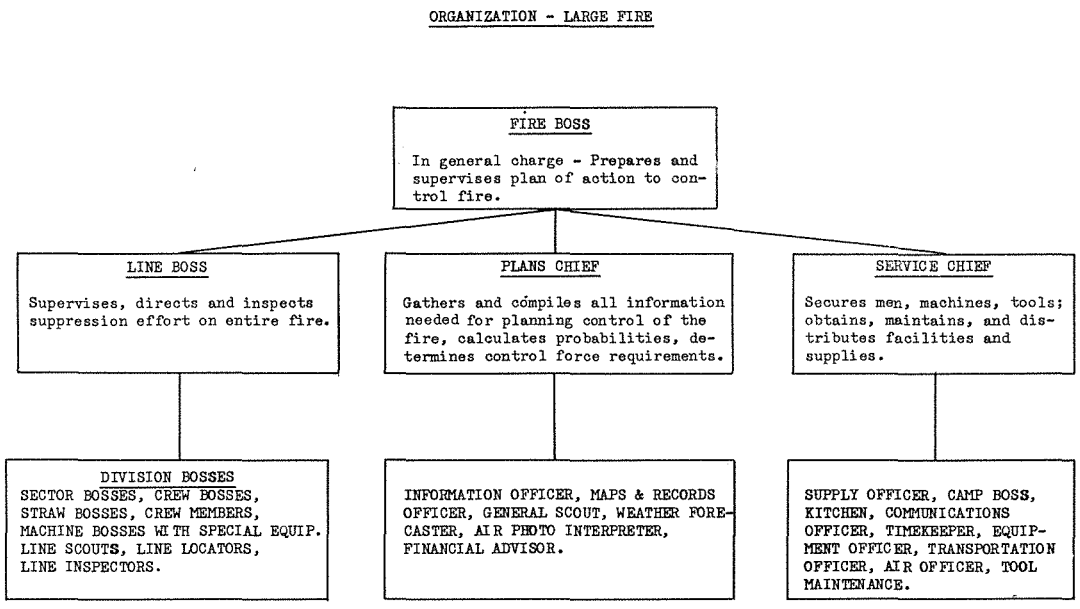

ORGANIZATION - LARGE FIRE
FIRE BOSS
In general charge - Prepares and supervises plan of action to control fire.
LINE BOSS
Supervises, directs and inspects suppression effort on entire fire.
PLANS CHIEF
Gathers and compiles all information needed for planning control of the fire, calculates probabilities, determines control force requirements.
SERVICE CHIEF
Secures men, machines, tools; obtains, maintains, and distributes facilities and supplies.
DIVISION BOSSES
SECTOR BOSSES, CREW BOSSES, STRAW BOSSES, CREW MEMBERS, MACHINE BOSSES WITH SPECIAL EQUIP. LINE SCOUTS, LINE LOCATORS, LINE INSPECTORS.
INFORMATION OFFICER, MAPS & RECORDS OFFICER, GENERAL SCOUT, WEATHER FORECASTER, AIR PHOTO INTERPRETER, FINANCIAL ADVISOR.
SUPPLY OFFICER, CAMP BOSS, KITCHEN, COMMUNICATIONS OFFICER, TIMEKEEPER, EQUIPMENT OFFICER, TRANSPORTATION OFFICER, AIR OFFICER, TOOL MAINTENANCE.

Fig. 207

The Sector Boss And Crew Boss

The Sector Boss is responsible for control of a specified portion of a large fire. To do the job he is assigned Crew Bosses who supervise workers in their particular jobs. He is also assigned Machine Bosses who are in charge of tankers, tractors, and power saws.

The following chart is a detailed breakdown of just the Line Organization portion of the Large Fire Organization chart, Fig. 208. It shows you the relationship of the Sector Bosses and Crew Bosses and just where they fit in the large fire organization.

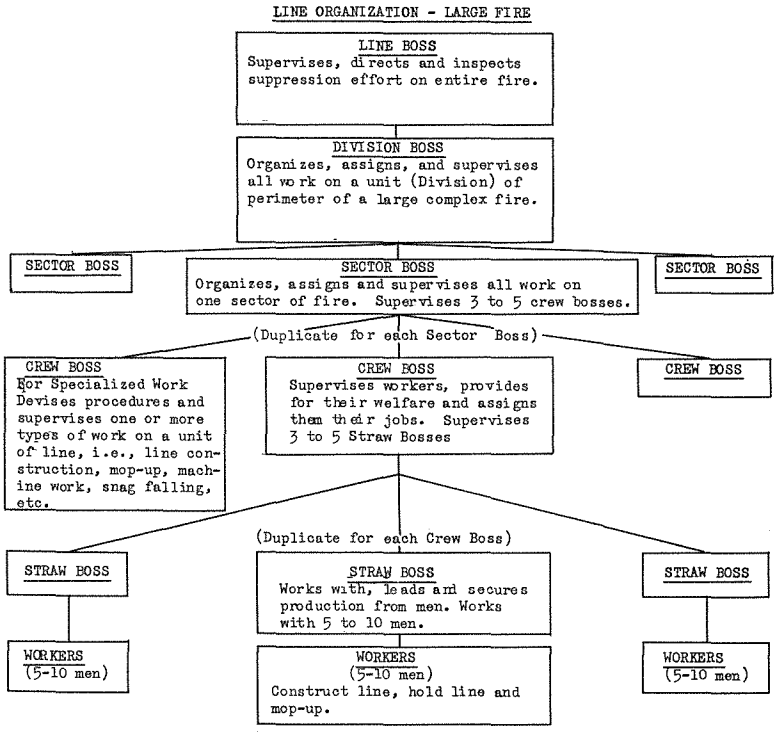

LINE ORGANIZATION - LARGE FIRE
LINE BOSS
Supervises, directs and inspects suppression effort on entire fire.
DIVISION BOSS
Organizes, assigns, and supervises all work on a unit (Division) of perimeter of a large complex fire.
SECTOR BOSS
SECTOR BOSS
Organizes, assigns and supervises all work on one sector of fire. Supervises 3 to 5 crew bosses.
SECTOR BOSS
(Duplicate for each Sector Boss)
CREW BOSS
For Specialized Work
Devises procedures and supervises one or more types of work on a unit of line, i.e., line construction, mop-up, machine work, snag falling, etc.
CREW BOSS
Supervises workers, provides for their welfare and assigns them their jobs. Supervises 3 to 5 Straw Bosses
CREW BOSS
(Duplicate for each Crew Boss)
STRAW BOSS
STRAW BOSS
Works with, leads and secures production from men. Works with 5 to 10 men.
STRAW BOSS
WORKERS
(5-10 men)
WORKERS
(5-10 men)
Construct line, hold line and mop-up.
WORKERS
(5-10 men)

Fig. 208

DUTIES AND RESPONSIBILITIES OF THE CREW BOSS AND SECTOR BOSS

The Sector Boss and Crew Boss each have many duties and responsibilities. These are listed on the pages which follow. They are grouped under logical headings to facilitate learning. It is suggested that you first memorize the headings, then learn the specific items under each heading.

THE CREW BOSS JOB

If you are a Crew Boss, you work for the Sector Boss. He will tell you what is expected from your crew. It's up to you to get it done safely, correctly, and on time. Also it's up to you to take care of your men, in camp and on the line.

Get Your Orders
from your Sector Boss.
Which crew is yours.
What time to leave camp.
How to travel.
Where to get tools.

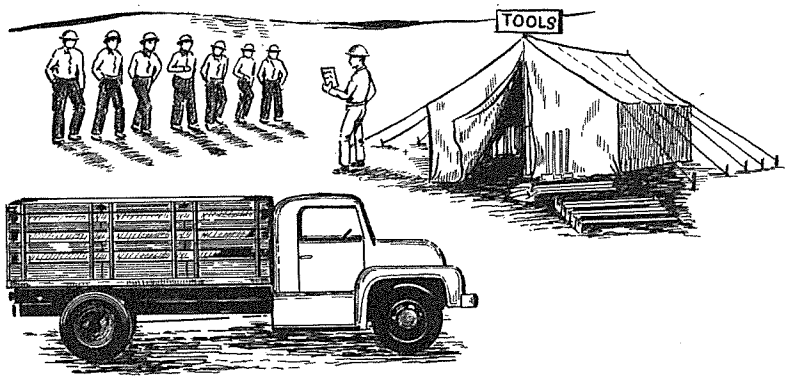


Fig. 209

Get The Men Ready

Get the men fed on time.
Check condition of their clothes and shoes.
Complete a Crew Time Report for your crew (2 copies).
Turn in carbon copy of time report to Time-keeper at beginning of shift. (At the end of the shift complete the original and turn it in to the Time-keeper.)

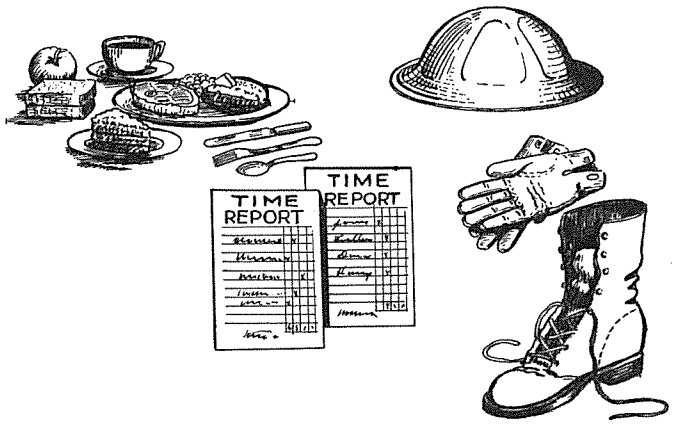


Fig. 210

See About Equipment

Are tools O.K. ?
Get list on tool requisition.
Get water and lunches.
Is transportation safe?
Get first aid and snake bite kits.
Turn in blankets.

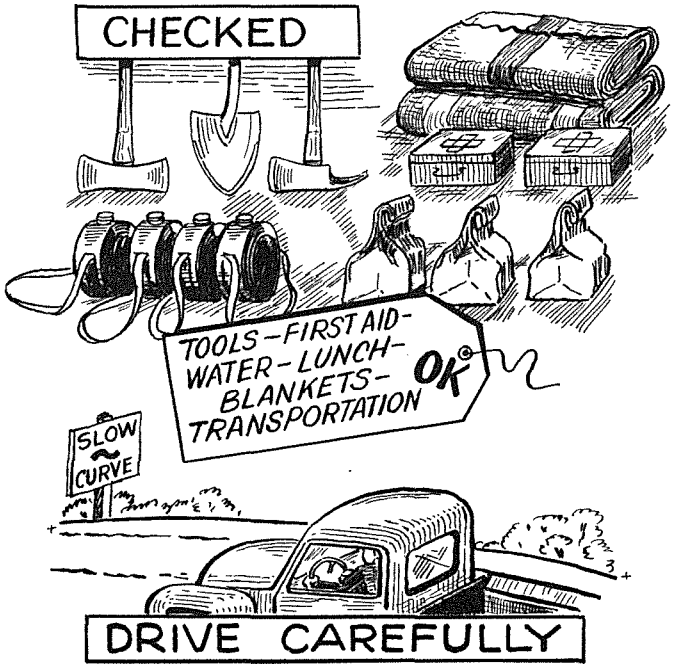


Fig. 211

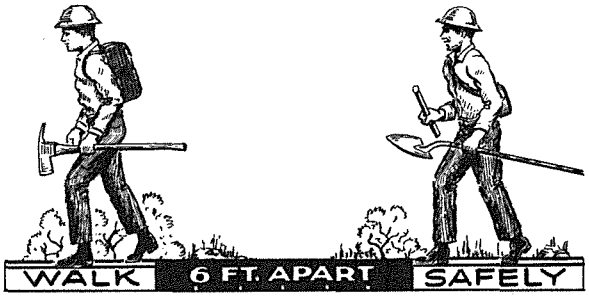


Fig. 212

Travel Safely

Drive carefully.
Walk properly.
Carry tools correctly.

Get Your Field Orders from the Sector Boss

Where to work.
What standards to meet.
When to finish.

Fig. 213

Get The Work Started Efficiently And Safely

Assign Straw Bosses and lay out the work.
Explain the work and teach the safe, effective way to do it.

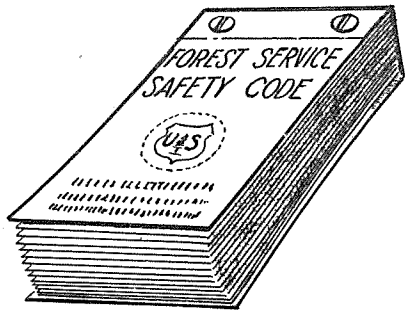


Fig. 214

Fig. 215

Direct The Work

Stay on the line; work with the crew until relieved.
Work with all Straw Boss groups.
See that the work is done correctly and safely. Avoid unnecessary work.
Smoke only in the burn or other safe places.

Look Ahead

Find escape routes or safety areas.
Tie in with adjoining crews.
Anticipate needs and tell Sector Boss.

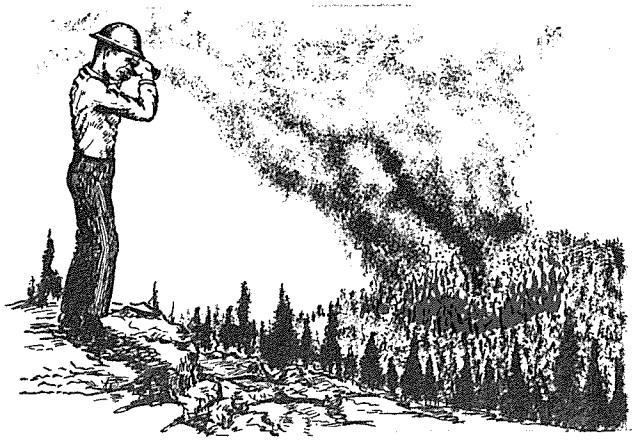
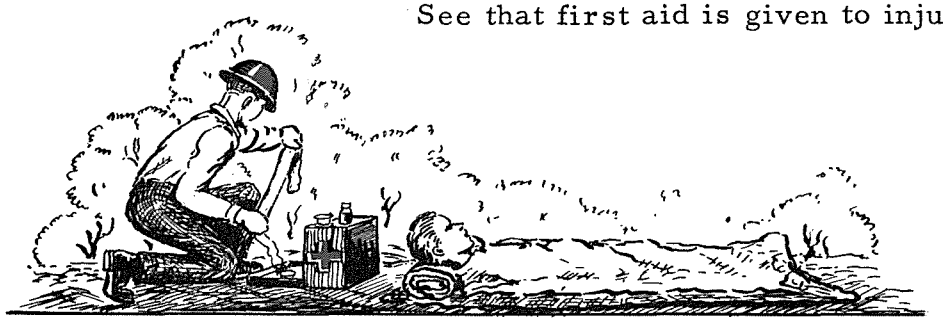


Fig. 216

Manage Your Men

Keep them spread out and working.

See that first aid is given to injured.



Report misfits to Sector Boss.

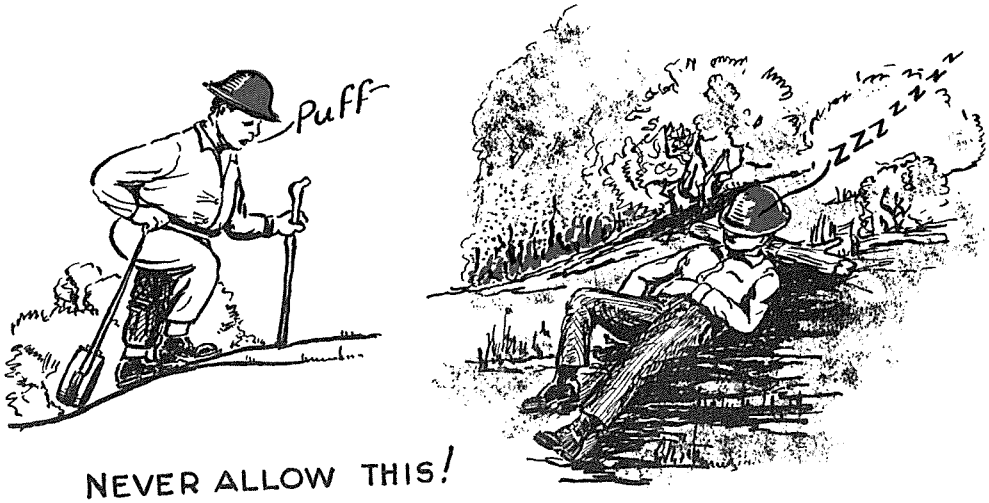


Fig. 217

Back At Camp

Turn in all tools.

Complete crew Time Report and turn it in to Timekeeper.

Tell men their hours worked.

Report any accidents and complete the necessary accident report forms.

See that your crew is fed.

Bed men in assigned area. Keep your crew together.

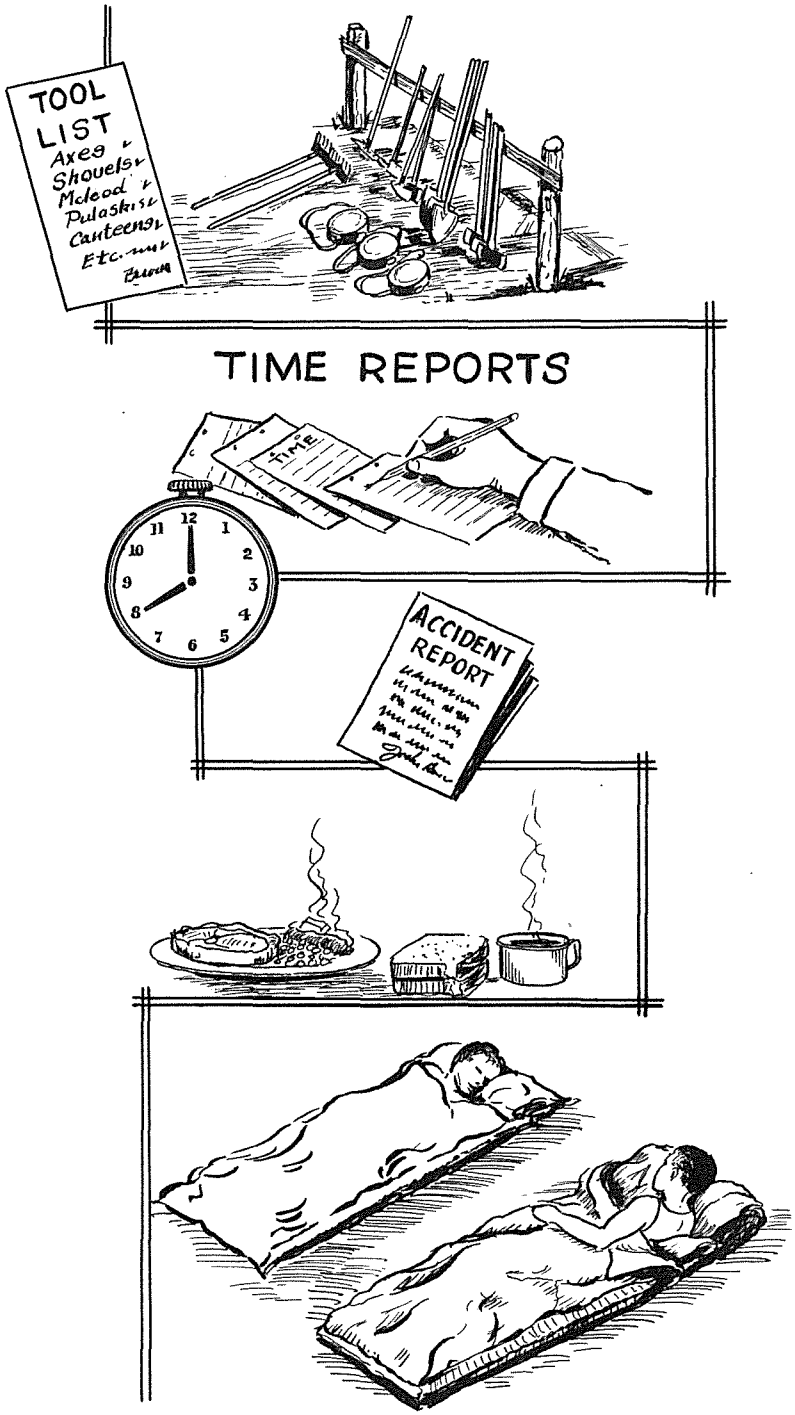


Fig. 218

THE SECTOR BOSS JOB

If you are a Sector Boss, you work for the Division Boss or Line Boss. He will tell you what must be done on your sector. It's up to you to get it done. The work of all the men and the machines on the sector is your responsibility. So are the welfare and safety of the men. This applies in camp and while working on the line.

Get Your Orders

From the Line Boss or Division Boss;

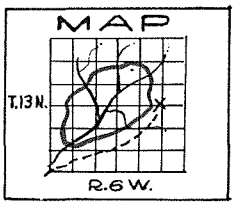


Fig. 219

In writing and with map;

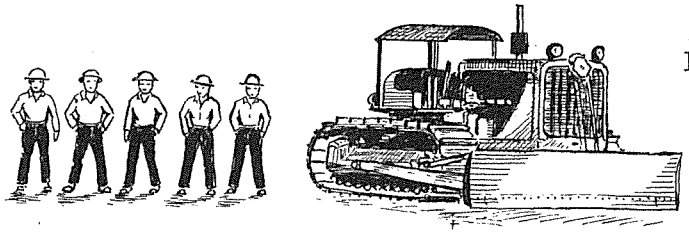


Fig. 220

Crews and machines assigned to you.

What the fire may do;

What work has been done;

Find out the location of your sector.

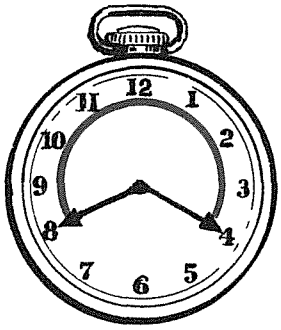


Fig. 221

When to start and finish; and

Who you tie in with and where.

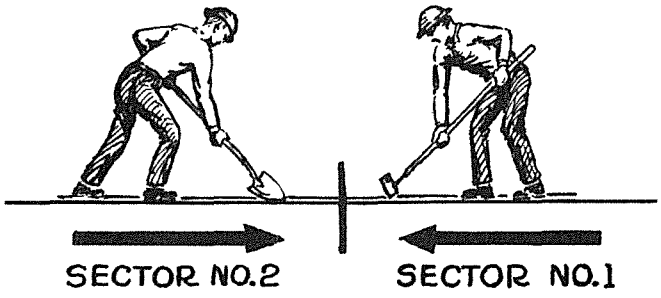


Fig. 222

Get Ready

Tell your Crew Bosses and Machine Bosses:

Which crews and machines they get.
Specific safety hazards to watch for.
Who is to load tools, water, lunches.
Where to go and how to get there.
What each crew is to do.

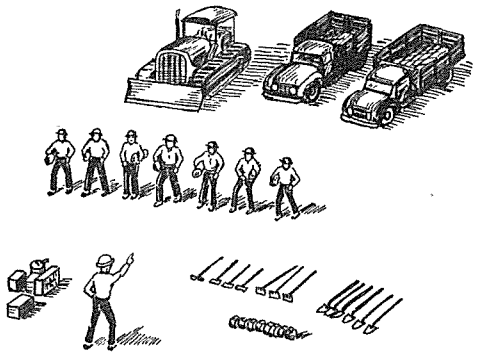


Fig. 223

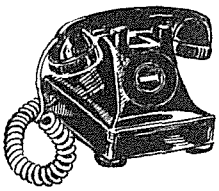


Fig. 224

Check up on communication procedures and equipment.

Prepare time report for Crew Bosses and Machine Bosses.

Fig. 225

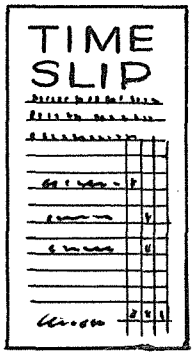


Fig. 226

See to it that:

Crew Boss time reports are made out, and that

Everything moves promptly and everyone gets out of camp on time.

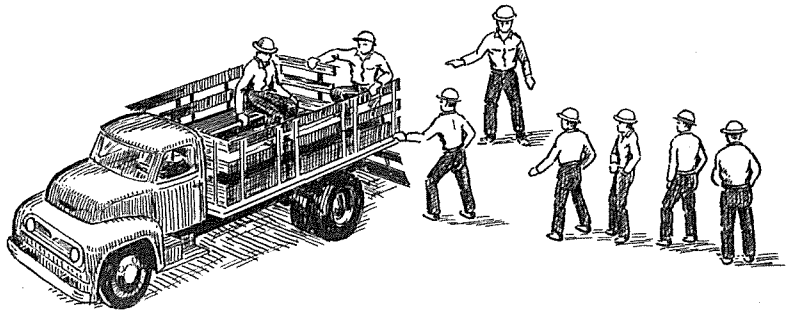


Fig. 227

Travel Safely

See that crews:

Drive carefully.
Walk properly.
Carry tools properly.

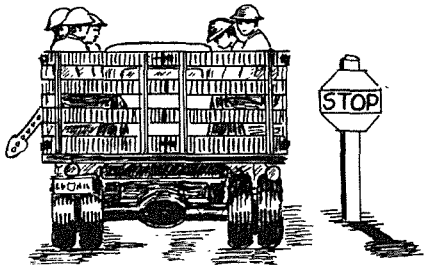


Fig. 228

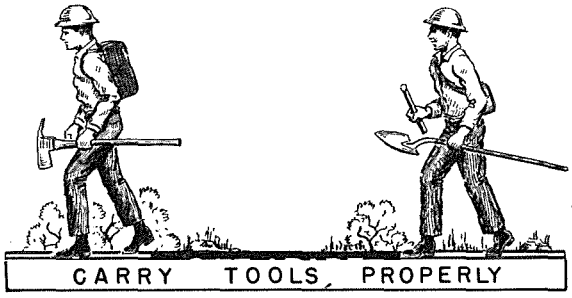


Fig. 229

Plan The Job

Look things over on the way to the fire line.
Try to talk to the outgoing Sector Boss.
Organize all your resources to to all parts of the job.
Figure out the bad spots and what to do first.
Locate the line, if not already done.

Do The Job

Plan it;
Assign the work;
Train help;
Check up;
Cooperate with other Sector Bosses;
Look ahead;
Plan emergency action, and
Carry it out.

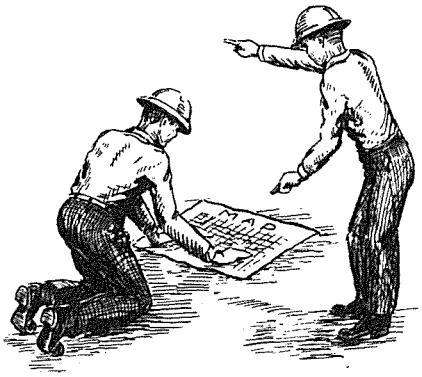


Fig. 230

Assign The Work To Crew Bosses And Machine Bosses

Lead your crews
to work.
Show Crew Bosses
where to work
and what to do;
How you expect
it done - and
safely.
When to start and
finish.
Who to tie in with,
and the line of
retreat in emergency.

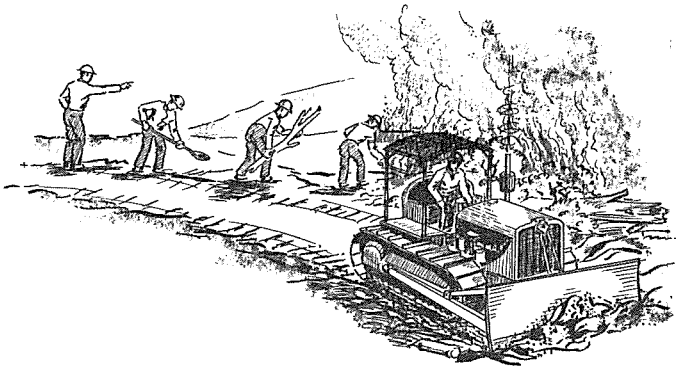


Fig. 231

Give above information also to Crew Bosses in charge of bulldozers, power saws, and tankers.
Tell your Crew Bosses about arrangements for water, lunches, fuel for machines, relief, and communications.

Train, Help, And Check Up

Inspect entire sector at least twice each shift.
Inspect critical areas more frequently.
If Crew Bosses don't know how to do a job, show them.
Stay on your sector until relieved.
Account for location and condition of crews and equipment at end of shift.

Cooperate With Others

Coordinate work with adjacent Sector Bosses.
Keep Division or Line Boss informed of progress and changes.

Look Ahead

See what is going to happen.
Anticipate needs of Crew Bosses.
Inform Crew Bosses of escape routes and safety areas.
Try to keep in radio contact with Crew Bosses.

Plan Emergency Action

You may change planned action only when:

1. Action as planned cannot cope with the situation, and
2. Division Boss, Line Boss or Fire Boss cannot be reached in time to discuss the situation, and
3. Your new action does not create a risk to the men, and an emergency situation has developed and you must take immediate action.

Back At Camp

1. Turn in completed time for your Crew Bosses to Timekeeper.
2. Report your own time to Division or Line Boss.
3. Turn in ratings on outstanding and unsatisfactory performance.
4. Turn in your shift accomplishment record.
5. See that Crew Bosses account for all tools.

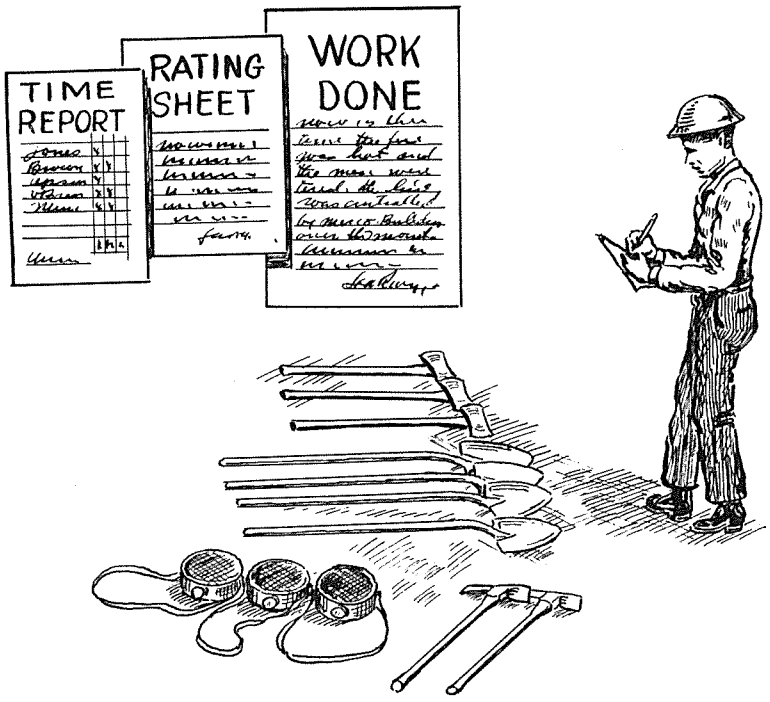


Fig. 232

ORGANIZING THE WORK ON THE SECTOR

FUNDAMENTAL PRINCIPLES

1. Assign men and equipment to jobs for which best fitted: bulldozers to build line on gentle to moderate slopes; hand crews build line on steep slopes; falling crews for snag falling and bucking logs out of the fire line.

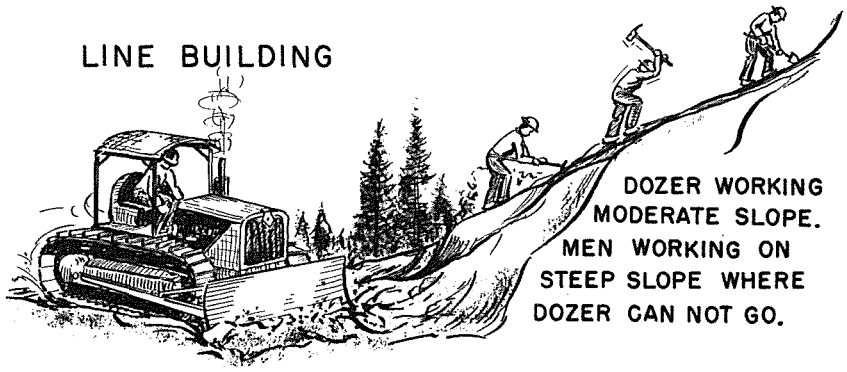


Fig. 233

2. Correlate the various jobs in the proper order to complete the whole job most efficiently.

3. Assign only one type of work to one unit of men or machines as a general rule. If the unit can do more than one type of work, assign the work in the order it is to be done.

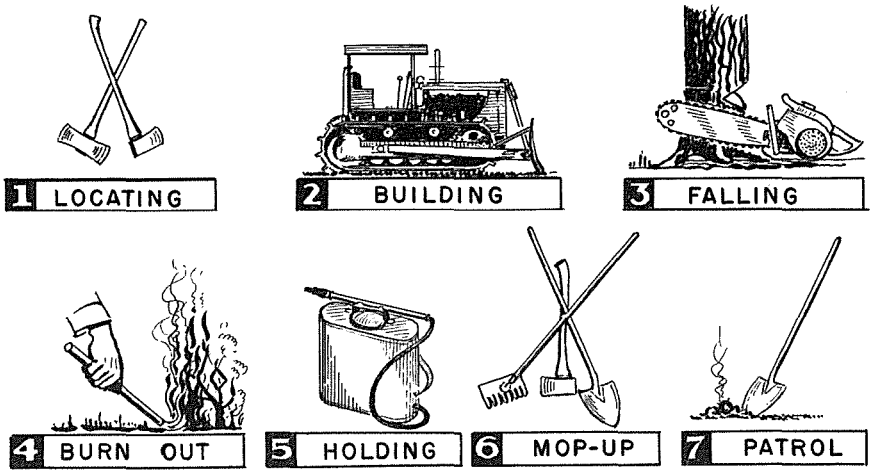


Fig. 234

HOW TO ORGANIZE THE WORK

1. Determine which of the following jobs need to be done: line locating, line building, snag falling, burning out, line holding, mopping up, patrol.

2. Find out what crews and equipment are assigned to the sector.

3. Find out when the various jobs must be completed on different portions of the sector in order to meet deadlines of fire strategy.

4. Appraise terrain of sector to determine whether each work unit should proceed clear through the entire sector; whether each should be assigned an area; or whether the two methods should be combined.

5. Consider the three fundamental principles listed on page 310 when organizing your crews.

6. Assign each unit its work, its area, and its time limit.

ORGANIZING THE CREW

A crew on a large fire may be assigned one or more of the following jobs:

Line Construction
Snag Falling
Burning out and Line Holding
Mop-up and Patrol.

The Crew Boss must organize his crew to complete more than one of the above jobs. However, for the sake of clarity each job will be considered separately.

Organizing The Line Construction Crew

Line construction should be progressive. The crew completes the line-building job as it goes, each man covering the entire line and doing a portion of the work. The first man will at least mark the line. The last man will complete the line. Men should not pass each other.

The Crew Boss will:

1. Determine the amount and nature of the work to be done: how much cutting, scraping, log bucking, and other special jobs.
2. Select, necessary tools in the proportions necessary to accomplish these jobs.
3. Assign tools and jobs to men on the basis of their qualifications.

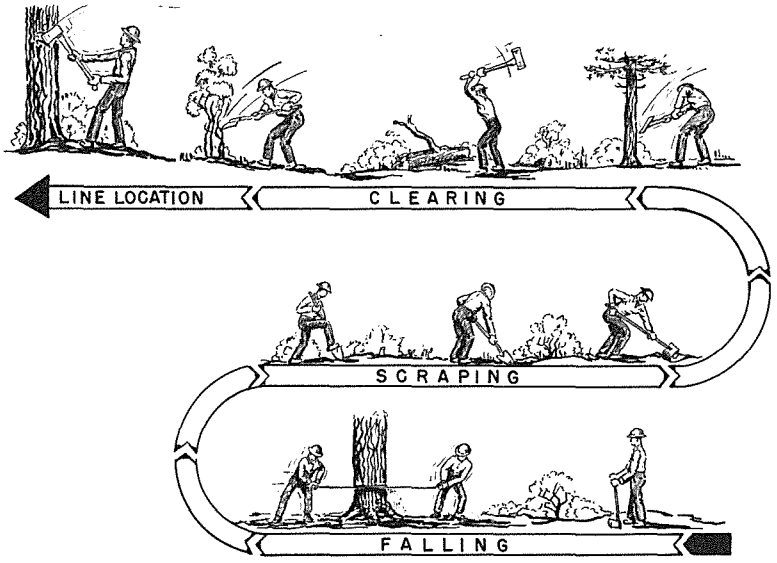


Fig. 235

Work proceeds as follows:

1. Men with cutting tools ahead, clear line to required width.
2. Men with scraping tools follow, scraping to required width and depth.
3. Cleanup men come last, falling snags, bucking logs, cutting roots, completing line to standard.

One man in each group should be assigned as a Straw Boss. Within each of the three groups of crewmen, work may be distributed in either of two ways:

1. Each man in a group may do only a portion of his assigned type of work on the entire line. For example, the lead cutting man may only mark and open up enough to get through. Succeeding cutting men each do their share, with the last one completing the cutting. Men with scraping tools divide the work in similar fashion.

2. Each man in a group completes his assigned type of work on portions of the line. For example, each cutting man completes the clearing on his section until one reaches the work of the man ahead of him. Then he and all ahead of him move forward.

Points To Watch...

1. Safety - men work at least 10 feet apart so they will not strike each other.
2. Distribution of tools - be alert to need for changes to maintain balance of work.
3. Pace set by the leader.
4. Make each man do his share.
5. Change tool assignments among the men for maximum efficiency.

Organizing The Snag Falling Crew

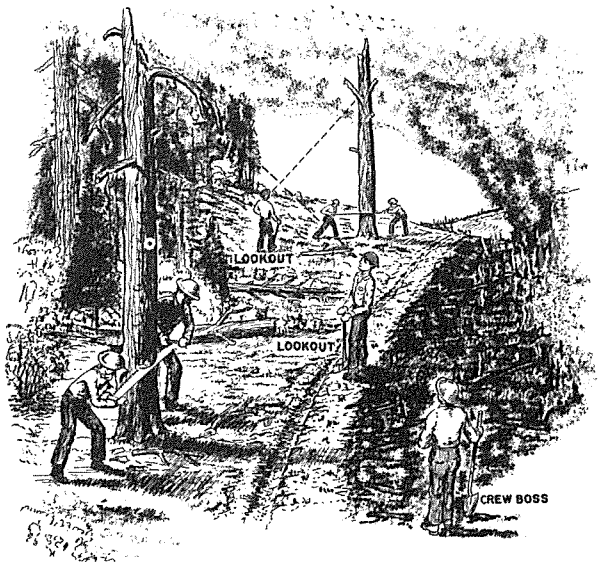


Fig. 236

1. Crew consists of one or more sets of fallers working under the direction of a Crew Boss or Saw Boss.
2. A set of fallers consists of three men when using a 2-man saw or power saw. The third man acts as a lookout for the crews safety to warn them of falling branches or tops.
3. Men alternate on lookout position.

Safety Rules...

1. Hard hats should be worn by all crew members.
2. Before felling, an experienced man should check each tree for top heaviness, direction of wind, nearness of other trees, nearness of people, dead or loose limbs, size of tree, direction of lean, soundness, slope of ground, species of tree, position of standing or down timber which might deflect tree to be cut.
3. A get-away route should be planned and cleared ahead of the felling job.
4. Before felling, clear enough space around base of tree and overhead to make plenty of working room and to provide escape in case of emergency.
5. Get a firm footing.
6. Shout "TIMBER" before tree begins to fall.
7. Get behind another tree and watch for falling limbs or other trees which may fall.

Good Practices...

1. All snags inside the fire line capable of throwing sparks across the line should be felled. Those closest to the line, especially if burning, should be felled first, <u>when safe</u> to do so.
2. Snags close to the line, outside the burned area should be felled if there is danger of their catching fire from sparks.
3. Snags near the fire line (inside or outside the burned area) should be felled away from the line.
4. If snag must be felled across the fire line, it must be bucked out where it crosses the line.
5. Spike-topped trees with fire in the top should be felled if close to the fire line.

Organizing The Burnout And Holding Crew

Burnout and holding must be closely correlated. The burning out must often be done quickly, but it is important not to give the holding men more fire than they can handle at any one time.

Burning tools must be selected according to the cover and the weather. Fusees are often suitable for dry grass. To get speed in brush and other fuels, torches may be required. Flame throwers are often necessary at times of high humidity, to get all unburned material inside the line to burn clean.

Tools for holding men will usually be mostly backpack pumps, shovels, and Pulaskis.

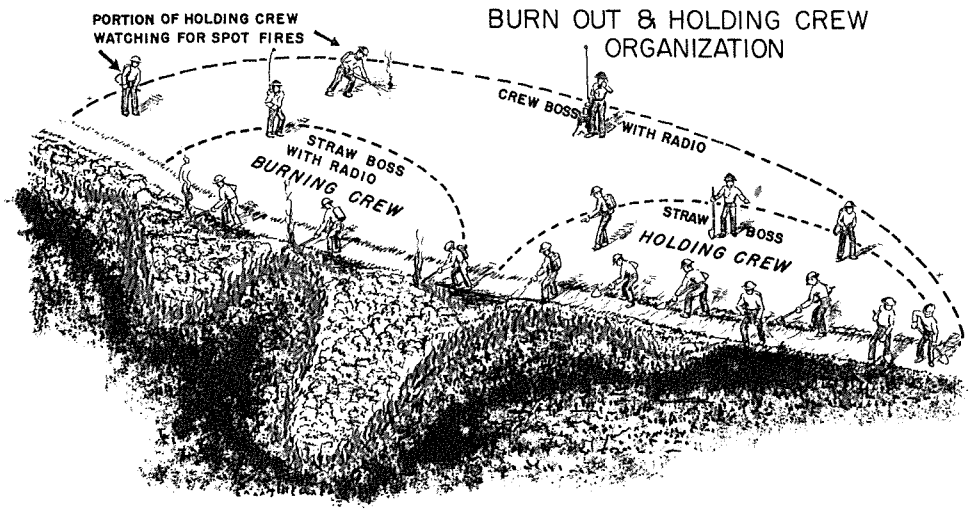

PORTION OF HOLDING CREW WATCHING FOR SPOT FIRES
BURN OUT & HOLDING CREW ORGANIZATION
CREW BOSS WITH RADIO
STRAW BOSS WITH RADIO
BURNING CREW
STRAW BOSS
HOLDING CREW

Fig. 237

Organizing The Mop-Up Crew

On all fires some mop-up work is done right along with the work of line construction and line holding. Generally, though, the bulk of the mop-up work especially in heavy fuels, remains to be done after the line is built, fired out, and held. When the mop-up job is large, special mop-up crews can be organized in the following manner:

1. The men are under supervision of a Crew Boss.
2. Crew is divided into two or more groups, each under a Straw Boss.
3. Each group works closely together to provide better supervision by Straw Boss.
4. Crew Boss locates work to be done, checks accomplishments, and provides general supervision.

Fig. 238

USE OF SPECIAL MACHINERY

Bulldozers, tankers, power saws, are specialized fire equipment. They are more effective than hand tools for some of the jobs in fire suppression. Where it can operate, a bulldozer will do the work of many men. Where the going is not extremely bad, a power saw will do as much work as several hand saws. Each unit (machines or crew) is assigned to the job it can do best. Special machinery must be correlated with hand work so the whole job gets done safely and quickly.

Fig. 239

Correlating Special Machines And Hand Crews

Special machinery must be correlated with hand work so that the whole job gets done as quickly as possible. In order to correlate the hand crews and machines the sector must be organized so that the work progresses systematically toward the control of the fire. An example of hand crew and machine organization is shown on the following page.

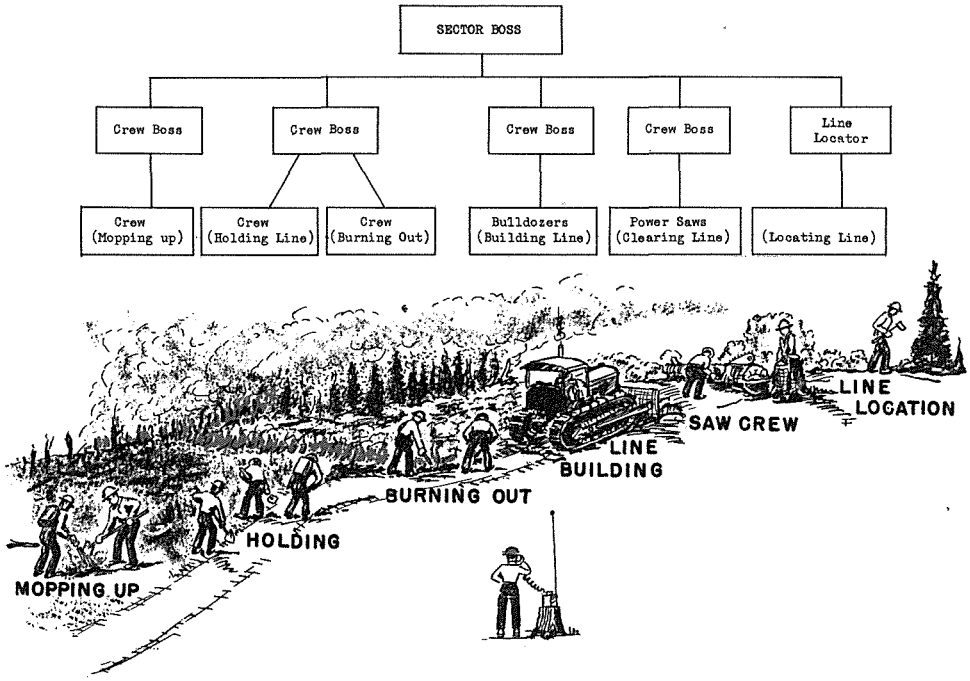

SECTOR BOSS
Crew Boss
Crew Boss
Crew Boss
Crew Boss
Line Locator
Crew (Mopping up)
Crew (Holding Line)
Crew (Burning Out)
Bulldozers (Building Line)
Power Saws (Clearing Line)
(Locating Line)
LINE LOCATION
SAW CREW
LINE BUILDING
BURNING OUT
HOLDING
MOPPING UP

Fig. 240

Bulldozers

Where to use: (Figures are for D-7 and are approximate.)

Downgrade: On slopes of 70% or less.
Upgrade: On slopes of 60% or less.
Sideslope: On slopes of 45% or less.

Heavy cover and rough rocky going will decrease the above figures.

Good Practices In Using Bulldozers

Line Construction...

1. Provide good supervision, operation, service, and line location. The machine justifies it; it replaces many men.
2. Follow the same fundamentals of line construction, width, depth, and length which apply to line construction with hand tools.
3. In line location and guiding dozers, avoid excessive slopes and rocks on which the machine can hang up.
4. Work dozers in tandem when possible. One dozer can rough out the line and the other finish it. If one hangs up, the other helps him out. This is especially good insurance when working near a fast-moving fire.
5. Always assign spotter to guide the lead dozer.
6. Provide two operators for dozer, per shift. They alternate. The one not on the bulldozer can serve as spotter.
7. If fire line goes through large logs, put saw crew out ahead to buck logs.
8. Push material away from fire whenever possible.
9. If not possible to push material away from fire, shove it well back into burn and spread it out. This avoids:

    a. Making hot spots along line. (Piles of hot burning fuels along line.)
    b. Dirt piles on top of burning fuel, (called cat piles) which hold fire for a long time.

10. Have dozer construct line just outside of fire edge to avoid carrying fire across the fire line.
11. Use dozer with canopy to protect operator.
12. Dozers not armored underneath should be assigned to easy going.
13. Bulldozers can often be used to make a fire line accessible to four-wheel-drive vehicles or to trailer tankers.
14. No one is permitted to ride on a tractor with the operator except a trainee operator or mechanic.

Mop-Up...

1. Push logs burning near the line back into the burn.
2. Roll large logs out of hot coals. Use water or hand tools to put out fire in them.
3. Cool hot spots, flare-ups, and hot burning areas with dirt. Then uncover, so they will not hold fire.
4. Push over short snags if the dozer has a canopy.

Servicing Bulldozers...

1. Plan to lube and fuel at each change of shift. Cat Boss, Sector Boss, and Equipment Officer must correlate on this.
2. Have water available at 3 or 4 hour intervals for refilling radioator on hot steep slopes.
3. Radiator should be kept clear of leaves and checked when dozer heats up.
4. Dozers should have small supply of tools such as open-end wrenches, pliers, and crescent wrench to effect simple repairs on the line such as replacing cable, or changing blade angle, or tightening hydraulic lines. Should also carry big beam lights, headlights, rations, first aid kits, and canteens while on line work.

Timekeeping...

Bulldozer hire is an expensive item in the control of a fire. It is therefore important to be businesslike about keeping track of dozer time. It is up to the Cat Boss to keep time on the dozers, using Equipment Time Report, and turn it in to the timekeeper.

Signals For Use In Directing Bulldozer Work...

Signals must be set up in advance of starting line construction and must be understood by all members of the dozer crew. The following are commonly used. They are given by spotter or Cat Boss.

1. Stop - Wave flag or light back and forth, waist high in swinging motion.

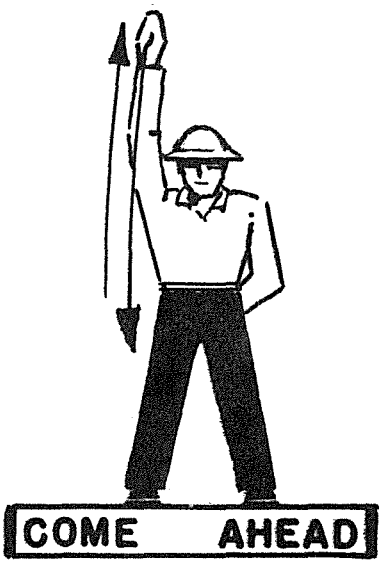


Fig. 242

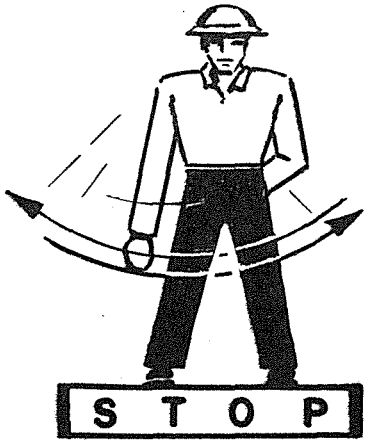


Fig. 241

2. Come Ahead - Up and down in front of spotter from the waist to arms length above head.

3. Turn - Swing the flag or light on the side to which the operator is to turn.

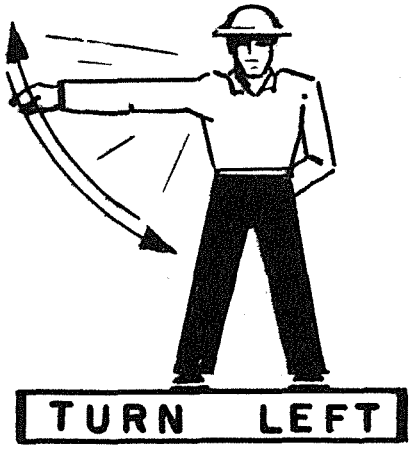


Fig. 243

4. Back Up - Full circle in front of the spotter.

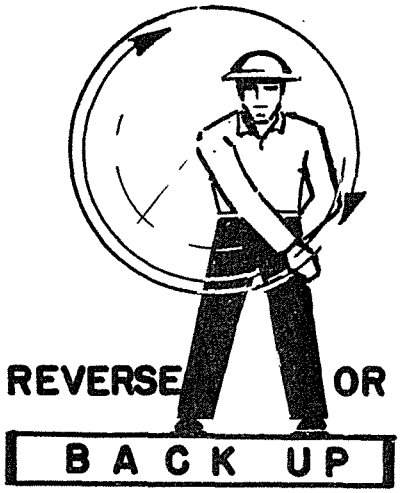
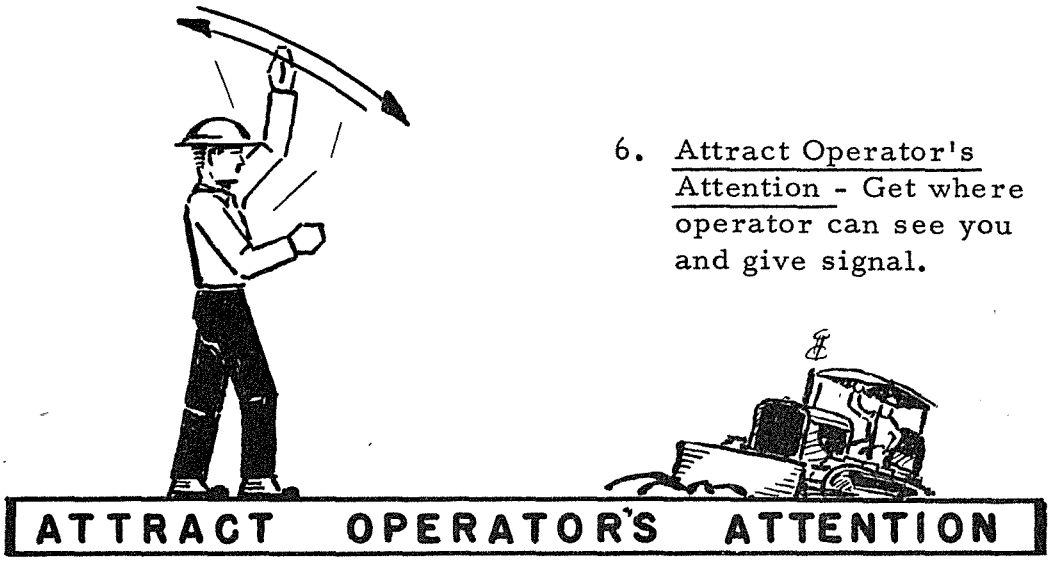


Fig. 244

Fig. 245

5. CAUTION - Wave flag or light in half circle at arms length above head.



6. Attract Operator's Attention - Get where operator can see you and give signal.

Fig. 246

7. Want Dozer Helper to Come to Dozer - Gun motor once. Signal is given by operator.

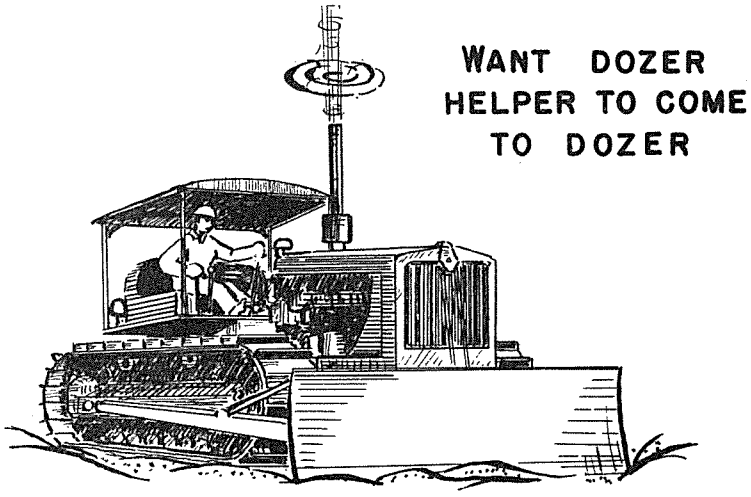


Fig. 247

8. Can't See Spotter - Gun motor twice. Signal is given by operator.

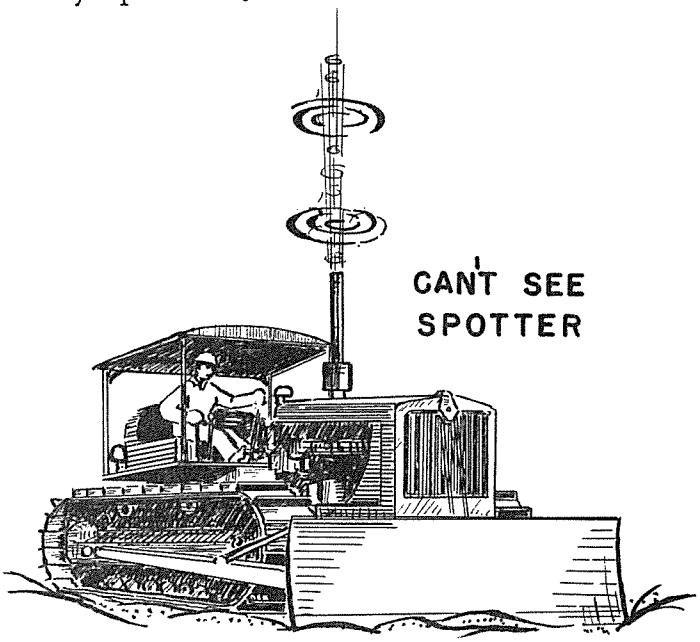


Fig. 248

Power Saws

Where To Use...

Power saws are very effective for almost everything that a hand saw will do, but will do the jobs much faster. A hand saw is usually more practical on (1) small back country fires and (2) isolated snags in very rough or steep country on larger fires.

Good Practices In The Use Of Power Saws

Generally the same good practice rules and safety rules apply in the use of power saws as in the use of hand saws. (See paragraph on "Organizing the Snag Falling Crew", page 313.) Additional safety precautions are required (1) because of the danger of injury from the saw chain; (2) because of the noise of the engine it may be more difficult to hear falling limbs or warnings from the lookout man.

Timekeeping...

In addition to keeping the time of the saw crews, the Power Saw Crew Boss also keeps a record of the running time of the power saws and reports it to the Timekeeper.

Other Specialized Firefighting Machinery

Other specialized machines have been developed and modernized, and new machines are continually being tried to reduce time, work, and costs of doing the firefighting job. These machines should be used wherever they will effectively supplement or replace hand work by doing the job quicker, easier, cheaper, or more efficiently. Some of the other specialized machines are airplanes, helicopters, pumpers, portable pumps, brush saws, brush cutters, brush mowers, and line trenchers.

REVIEW QUESTIONS - SPECIAL MACHINERY

1. Who does the Cat Boss work for?

2. Roughly, what is the maximum safe slope for a D-7 working downhill? Uphill? Sidehill?

3. True or false: The fundamentals of line construction are the same for hand tools and bulldozers.

4. Why should dozers avoid large rocks?

5. Give two reasons for pushing material away from the fire whenever possible. When impossible, what further action should be taken?

6. Why is it bad business to get on or off a moving bulldozer? (Answer not in text. You figure it out.)

7. A hot spot, close to the line, has been cooled off by covering with dirt. What remains to be done? Why?

8. When should a dozer usually be lubed and fueled?

9. Who keeps time on bulldozers? Power saws?

CHAPTER VIII

COMMUNICATION

COMMUNICATION

Prompt, dependable communication is an important part of effective fire control work. Some stations are furnished with radio for communication, others with telephone. Some may have both. Any failure of your radio or telephone requires prompt investigation and repair by the responsible person. Your job instructions will tell you what to check if communication failures are your responsibility, and how you can discover the reason for the failure.

DAILY CHECK CALLS

Daily check calls will be arranged with your headquarters for specific times of the day. The time for these calls should be stated in your job instructions. The purpose of the check calls is to determine whether or not your telephone or radio is working properly. If it is not, it can be repaired before it is needed for an emergency call, such as reporting a fire.

TELEPHONE

GOOD TELEPHONE USE PRACTICES

(Applies primarily to F. S. party lines equipped with hand generator -- "crank" phones.)

1. Be courteous.
2. Listen before ringing. Ask if line is busy; if not busy, then ring.
3. If others are using the line, hang up and wait until they are through unless your message is of an emergency nature.
4. If you have an emergency message, break in on the conversation and ask to use the phone.
5. Answer your ring promptly. Don't listen in on other rings.
6. Make your check calls promptly at assigned time.
7. If unable to ring headquarters, call the nearest phone on the line and have them try to ring for you.

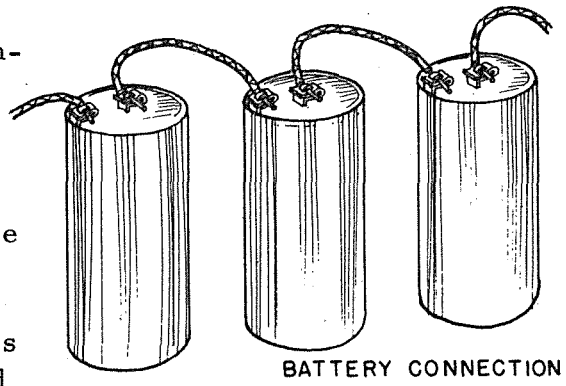
8. Make your conversation no longer than necessary -- especially if someone else wants to use the line.
9. On a party line, when through talking, ring a short ring to indicate conversation is finished.
10. Be sure to disconnect temporary phones after completing calls.
11. Keep receiver on hook when not in use.

TELEPHONE INSTALLATION

Dependable telephone service demands proper installation and good maintenance.

When checking or installing a telephone do the following:

1. See that the telephone box is solidly fastened to the wall with screws.
2. Test the batteries. (See Fig. 250.) If they are weak or old, replace them with new batteries and destroy the old batteries.
3. Replace all batteries when needed, not just one. Write the date and your initials on new batteries when installed.
4. Be sure that battery connections are tight and connected properly. Two or more batteries are connected in series -- Negative (-) of one battery to Positive (+) of other battery.
5. Be sure all telephone connections are clean and tight.
6. All wiring should be properly insulated.
7. Main line and ground wire connections must be soldered or clamped.
8. Place lightning protectors so printing is right end up.


BATTERY CONNECTION
Fig. 249

9. Drive ground rod in earth, full length, if possible, directly under protector.
10. Post up-to-date call card at telephone.

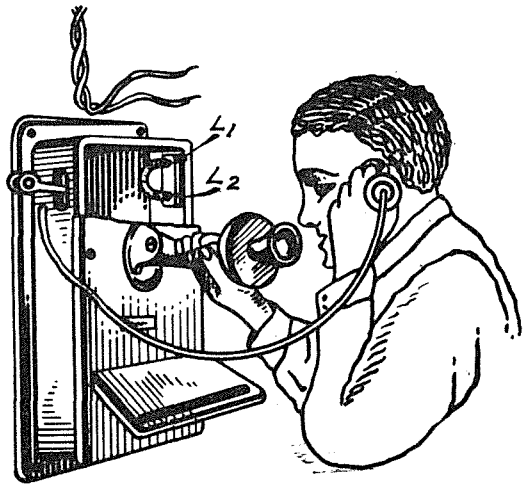


Fig. 250

Testing Transmitter and Batteries

a. Disconnect line wires at L1 and L2.

b. Connect a jumper wire between these two posts (or short between L1 and L2 with a screwdriver.)

c. Hold receiver to ear and blow lightly into transmitter or tap lightly.

d. If nothing is heard, then batteries are dead or transmitter is packed. (Carbon particles compacted.)

e. Tap transmitter sharply with fingers to loosen carbon particles. If noise still isn't heard, batteries are dead. (See Fig. 253.)

TELEPHONE TROUBLE SHOOTING

Telephone trouble shooting may be a hazardous job. Before you do any work of this kind read the telephone maintenance chapter in your "Forest Service Safety Code". You will have two types of telephone lines to work on: "metallic circuits" and "grounded circuits". Both types are used by the Forest Service.

Metallic circuit refers to a phone circuit using two wires between telephones. These wires are generally firmly secured to the insulator at each tree or pole so that the wires are kept tight enough to prevent them from contacting each other. (Contact causes a short in the circuit.)

Grounded circuit refers to a phone circuit which has only one wire and uses the ground for the return circuit. The circuit is completed by a contact with the ground at each instrument. The wire of a grounded circuit generally has more slack than a metallic circuit and slips freely through the insulators on trees so that if a tree falls across the line, the wire can reach the ground without breaking.

Here are some common telephone troubles and the probable causes of the trouble:

Telephone Generator Crank Turns Hard

What to look for:

1. Line wires crossed or contacting each other (if a metallic circuit).
2. Line wire grounded (metallic or grounded circuit).
3. Lightning protector block ground (temporary remedy -- remove from circuit).
4. Lightning protector shorted by lightning (temporary remedy -- remove protector tube).

Telephone Generator Crank Turns Easier Than Usual

What to look for:

1. Break in the telephone line circuit.
2. Broken or disconnected wire in instrument.

Telephone Bell Does Not Ring Or Rings Faintly When Others Call

What to look for:

1. Defective ringer, circuit broken or ringer out of adjustment.
2. Broken wire or loose connection in telephone set.
3. Short circuit in your telephone or some other telephone on the line.
4. Receiver off the hook at some other telephone on the line.
5. Open or blown fuse at the lightning protector on the outside of the building.
6. Broken line wire or service wire.
7. Line wire grounded by touching trees, brush or ground, if grounded circuit.
8. Overloaded line, too many telephone instruments on the line.

Bell Rings Frequently Without Apparent Cause

What to look for:

1. Line crossed with other telephone line.

You Cannot Ring Bells Of Other Telephones

What to look for:

1. Defective generator (Magneto).

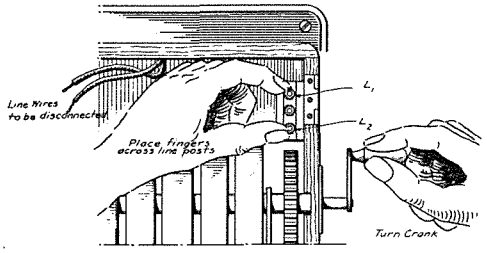
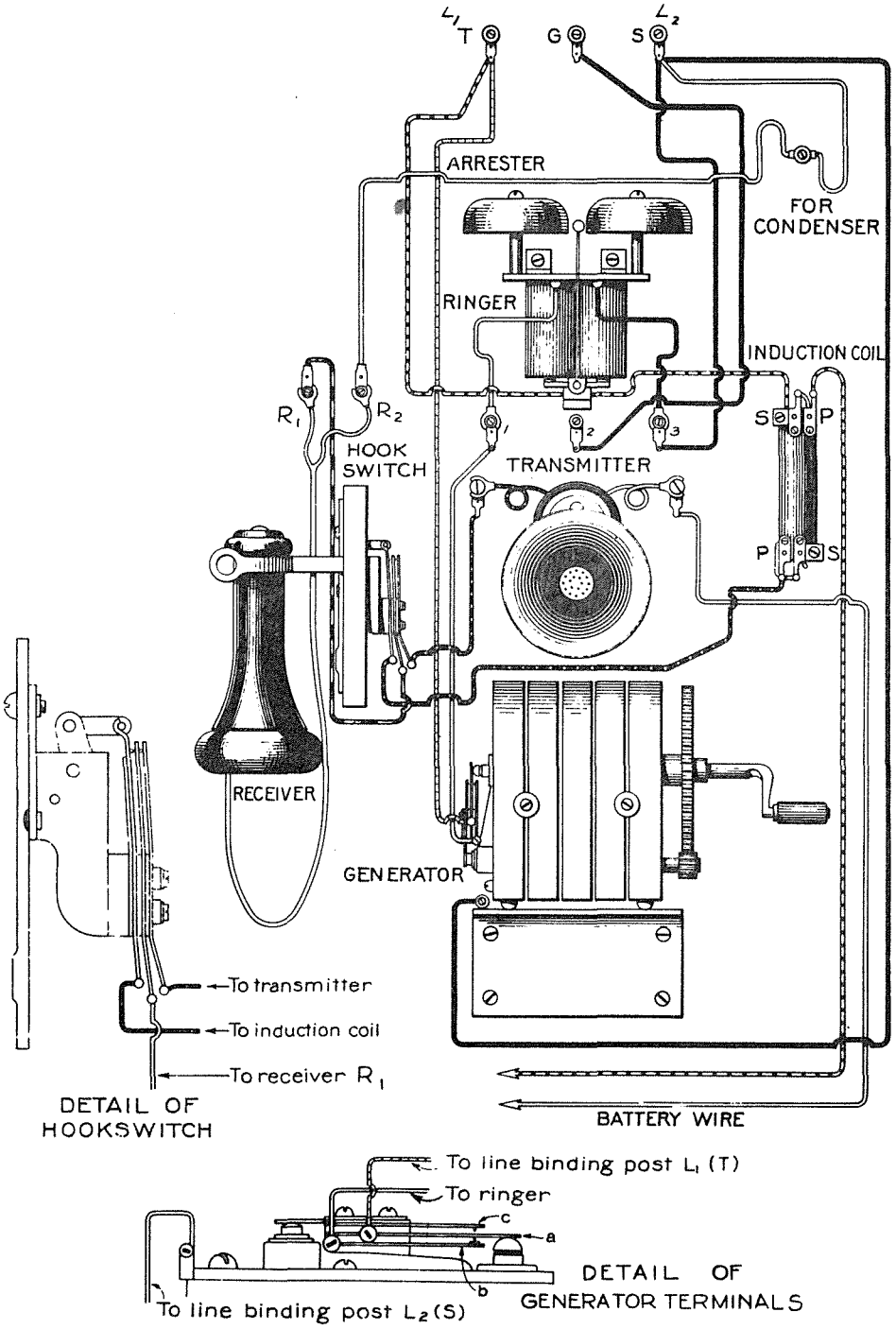


Fig. 251
Testing Magneto With Finger



WIRING DIAGRAM OF KELLOGG TELEPHONE

Fig. 252

2. Broken wire or loose connection in telephone set.
3. Open or blown fuse -- replace or temporarily bridge across fuse connection with a wire until the fuse can be replaced.
4. Short-circuited line, if metallic circuit.
5. Line wire grounded by touching trees, brush or ground, if grounded circuit.
6. Broken line wire or service wire.
7. Inadequate ground or poor connection on wire to ground rod.
8. Overloaded line, too many telephone instruments on the line.

You Cannot Make Others Hear You Talk

What to look for:

1. Batteries weak or improperly connected.
2. Switch of receiver hook out of adjustment or contacts poor.
3. Loose or defective connections to transmitter.
4. Poor connections on receiver circuit of telephone being called.
5. Transmitter is packed (carbon particles in transmitter become compacted). Remedy -- tap sharply with fingers on side of transmitter.

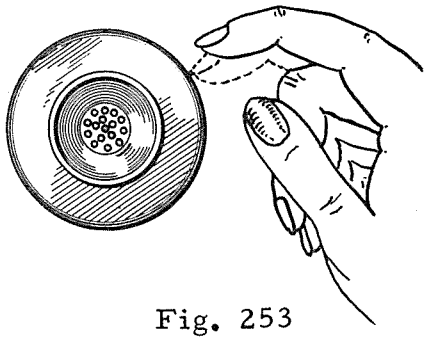


Fig. 253

You Cannot Hear Others Talk

What to look for:

1. Receiver or receiver cord is broken. Connect one end of receiver cord to a battery post. If O.K., a click will be heard when other end is touched to opposite battery post. If no click, line is probably broken.

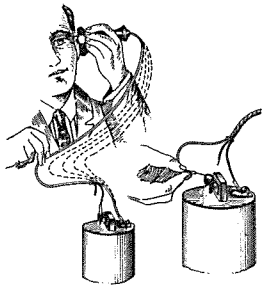


Fig. 254
Testing the Receiver Cord

2. Defective or dirty receiver; remove cap, clean and tighten connections.
3. Loose or broken connections in telephone.
4. Switch of receiver hook out of adjustment or contacts dirty.

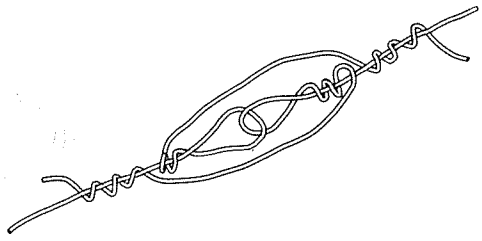
Your Conversation Is Interrupted So That You Hear Only Parts Of Conversation

What to look for:

1. Loose connections somewhere on line.
2. Poor ground, if grounded circuit.
3. Line wires swinging together or grounded intermittently.
4. Line wire swinging against lightning rod on poles, guy wire or other ground.
5. Loose splice in line wire.
6. Line crossed with other telephone line.
7. Loose connections in battery circuit.

TELEPHONE LINE MAINTENANCE

Temporary repair should be made, if possible, when trouble is discovered. Report temporary repairs to your superior as soon as possible. In this way, permanent repairs can be made by a qualified telephone man. Temporary emergency splices can be made as illustrated.



EMERGENCY MAINLINE SPLICE

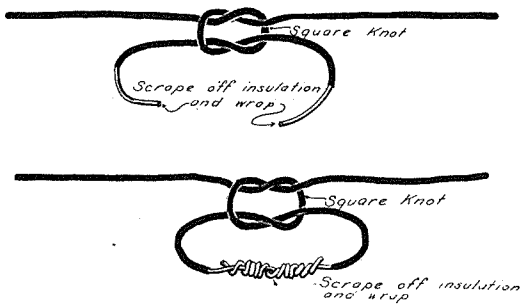


Fig. 255

Emergency Mainline Splice
and
Std. Emergency Wire Splice

RADIO

Forest Service radios are to be used only for official business. Our radio use is being systematically monitored by the Federal Communication Commission. Always remember that many private citizens have radio receivers capable of receiving our transmissions. Also most of our cooperators monitor our frequencies for informational purposes. Because of this, you should always be careful of the language used and refrain from making statements which might be embarrassing to yourself and the Forest Service.

GOOD RADIO USE PRACTICES

1. Always be courteous.
2. Use proper language. Swearing and obscene language is prohibited.
3. Answer your radio call promptly.
4. Think through your message before starting to transmit.
5. Be brief. Radio channels are crowded.
6. If others are using the air, wait until they are through unless your message is of an emergency nature.
7. If yours is an emergency message, break in on the conversation and ask for the air.
8. Pronounce your words distinctly.
9. Talk into the microphone.
10. Use normal tone of voice.

Every effort possible should be made to use radios correctly. Correct use permits proper understanding of your message and results in prompt action. Delays mean loss of minutes and minutes count in fire suppression work. The proper procedure in transmitting a message is as follows.

MESSAGE PROCEDURE

1. In transmitting messages, always give the call number of the station you are calling first, followed by your call number.

2. All messages must be brief and to the point. Pronounce words distinctly and rather slowly. Finish quickly -- the air time may be needed for fire business. If possible, write your message first, then read it rather slowly and distinctly over the air. All lengthy messages should be written. The normal dispatch rate should be 40 to 60 words per minute.

3. Use the Radio Code "Ten Signals" (see page 337) whenever possible to brief your messages.

4. When you are through transmitting (message given, and reply received) you should terminate the conversation by giving your call number. This indicates the air is clear for communications by others.

MESSAGE PRIORITIES

When radio traffic is exceptionally heavy, it is sometimes necessary to set priorities on the various calls to be relayed. These priorities are as follows:

1. Messages concerning medical aid.
2. Messages concerning fire suppression.
3. Messages concerning food, equipment, tool orders, and other such items.
4. Administrative business.

RADIO CODE OR "TEN SIGNALS"

TEN SIGNALS are used to abbreviate certain phrases commonly used in radio messages. They are also more distinctly heard by the receiving station, for other phrases are easily distorted or are not phonetically perfect on the air. For example, the term "O.K." is not as readily understood over the air as "Ten Four". Learn these signals and use them whenever possible. They reduce transmission time and leave no doubt of your meaning. The TEN SIGNALS most commonly used in Forest Service work are as follows:

CODE SIGNAL	MEANING
10-1	Receiving poorly.
10-2	Receiving well.
10-3	Stop transmitting.
10-4	O.K. or Received Message.
10-7	Out of service. (Radio turned "off".)
10-8	In service. (Radio turned "on".)
10-9	Repeat, receiving conditions bad.
10-19	Return to your station.
10-20	What is your location?
10-21	Call this station by telephone.
10-23	Standby.
10-26	Any message for me?
10-50	Call my home.
10-97	Arrived at scene.
10-99	Change your location.

Examples of regular usage of the TEN SIGNALS are:

1. When a signal (message) is not clear or is received faintly, say "your signal is TEN-ONE (10-1)."
2. When you understand the message or acknowledge instruction, say "TEN-FOUR" (10-4) instead of O.K. or "I understand."
3. Before turning off your radio, say "Car Twenty-four sixty-nine (2469) is TEN-SEVEN (10-7) at headquarters."

This tells the Dispatcher that you are off the radio at your headquarters.

4. When you turn on your radio after a period of non-use, say "Bear Flats if TEN-EIGHT (10-8)". This informs all stations on the air that you can now be reached via radio.
5. Ten signals should be spoken as "TEN-EIGHTEEN" or "TEN-TWENTY-ONE", not "one-zero-one-eight" or "one-zero-two-one".

RADIO TROUBLE SHOOTING

Radios are technical pieces of equipment which may get out of adjustment easily. For this reason, only qualified technicians are permitted to work on the set.

Each day you should make the assigned radio check calls to determine if your set is in working order. If you find it is not working properly, then check the following:

Battery

1. Check batteries for correct wiring according to diagram furnished.
2. See that battery connections are tight.

Antenna

1. See that antenna wire is connected and antenna in place.
2. See that antenna does not touch trees, bushes, or other objects.

Receiver

1. Inspect headphone cord to see that it has not been injured and is plugged in correctly.
2. The dial adjustment is very sensitive on tunable receivers. Tune slowly in order not to slip past a station.

Transmitter

1. Inspect microphone cord to see if it is plugged in properly, or if it has been damaged.

General Trouble

1. Don't give up the first time. Try your call again. Station you are calling may not be on the air at the moment, or may be busy with other conversation you cannot hear. Some unusual atmospheric condition may be affecting reception, or conditions may be poor in the middle of the day and improve towards evening.
2. Try shifting position of antenna or your location (if radio is not stationary).
3. If you cannot get the station you want, try contacting another station and have them relay for you.

If the trouble is not corrected after these checks, notify your superior by telephone or other means. A qualified technician will be dispatched to work on the set.

CARE OF HANDIE TALKIE SET

1. Keep the set in carrying case at all times.
2. Always keep handset in holder provided except when in actual use.
3. Turn off switch when set is not in use.
4. Protect the set from moisture, excessive heat, dirt, crushing, sharp jars, and excessive vibration.
5. The safety knob on the antenna is for your protection; notify your immediate superior at once if it is damaged or missing.

RADIO SAFETY HINTS

1. Due to the high voltage in certain circuits, only qualified technicians shall be allowed to work on radio equipment.
2. During lightning storms, do not use radios when storm is within 1 mile.

3. A radio transmitter shall not be used within 300 feet of electric blasting.
4. Do not carry electric blasting caps in radio-equipped cars or trucks.
5. When using car radio, driver shall slow down or preferably stop except during emergencies.
6. All whip antennas shall be equipped with safety knobs.

LIGHTNING STORMS

The following instructions should be posted near all radio equipment located in exposed structures:

1. When a lightning storm is more than 1 mile away, the radio receiver may be left operating, but touching the controls of the equipment should be avoided until the storm has passed.
2. When the storm is less than a mile away, it is desirable, although not essential, to shut off the master switch on the equipment.

CAUTION: Since shutting off the equipment requires touching the instrument panel, this should be done immediately following a local flash and the equipment avoided thereafter until the storm has passed.

COMMUNICATION REVIEW QUESTIONS

1. What is the usual indication of a ground or short on your phone line? Of a break in circuit?

2. Name three things which may be responsible for failure of telephone bell to ring.

3. What are three things which may prevent your voice from being heard on other end of the line.

4. What are three causes for intermittent, broken, or interrupted conversation on the line?

5. What effect do poor splices have on a line?

6. What action should you take if your phone is not working?

7. Is it permissable to gossip or conduct personal conversation on Forest Service radios?

8. If your message is lengthy, what action should you take before transmitting?

9. Are you permitted to work on radio circuits inside the cabinet? Who is?

10. What action do you take, if, after checking for radio trouble, your set still fails to operate properly?

11. Name five items in care of Handie Talkie sets.

12. How are the Ten Signals used? Give the meaning of 6 Ten Signals.

13. What type of message has highest priority on the air? Which is the lowest priority?

CHAPTER IX

FIRE LINE FIRST AID

FIRE LINE FIRST AID

HOW TO PREVENT INJURIES

(See also Forest Service Safety Code - pages 181-187.)

1. Before going on fire line brief men on safety. Use Safety briefing outline. Check men for physical condition, footwear, clothing.

2. Check the Forest Service Safety Code for safety rules before undertaking any new type of job.

3. REMEMBER -- only YOU can Do Your Job Safely!

IF INJURIES DO OCCUR

1. Give first aid for any injury or illness, however minor.

2. For serious injuries give proper first aid and get medical aid as soon as possible.

FIRST AID

Forest Service regulations state: "All supervisory personnel, either seasonal or regular, who may be called upon to aid injured employees or citizens in areas under Forest Service jurisdiction, shall have an American Red Cross Standard First Aid Certificate or equivalent and their knowledge shall be kept current by refresher courses taken at not less than three year intervals." Do you have a card?

GENERAL DIRECTIONS

1. Keep the injured person lying down in a comfortable position, his head level with his body, until you know whether the injury is serious.

2. Look for serious bleeding, stoppage of breathing, poisoning, shock, wounds, burns, fractures, and dislocations. Be sure you find all injuries. REMEMBER: (1) Serious

bleeding, (2) stoppage of breathing, and (3) poisoning, in that order, must be treated immediately, before anything else is done.

3. Keep injured person warm.

4. Send someone to call a physician or an ambulance.

5. Keep calm and do not be hurried into moving the injured person unless it is absolutely necessary.

6. Never give water or other liquids to an unconscious person.

The symbols * and ** in the following list of injuries indicate: * = Immediate action cases. ** = Special care needed.

*Shock

REMEMBER: Any severely injured person will develop shock and treatment must start immediately without waiting for symptoms of shock to develop. Symptoms are: pale face, breathing shallow and irregular, nausea, skin cool and moist, pulse weak.

Treatment: (1) Conserve body heat by wrapping patient underneath and above. Do not apply external heat except in extremely cold weather. Patient should be comfortable, but not hot. (2) Keep patient lying down with feet raised. (3) Fluids may be given by mouth unless patient has abdominal injury or is unconscious. Water, hot tea, coffee, milk, or broth may be given.

Note: In cases of head or chest injury, or if face is flushed as in sunstroke, keep patient lying down, but with head higher than feet.

*Wounds With Severe Bleeding

1. Use direct pressure on wound. Place thick layer of gauze

on wound and apply firm pressure until bandage can be put on. Also press with finger at arterial pressure point to help stop flow of blood.

2. If direct pressure is difficult to maintain and the bleeding is from a limb, a tourniquet may have to be used. Apply tourniquet at leg or arm tourniquet point. Loosen the tourniquet every 15 to 20 minutes. Warning: A tourniquet is always a dangerous instrument and should not be used if bleeding can be checked readily otherwise.

3. Treat for shock.

*Overcome By Smoke, Asphyxiation, Stoppage Of Breathing

1. Start artificial respiration immediately.

2. Move patient into open or clear air.

3. Loosen clothing, check for obstructions to breathing in mouth.

4. Check for wounds.

5. Treat for shock.

*Poison, Internal

For general first aid, remember two practices:

1. Dilute. Give patient large amounts of fluid such as soapsuds, salt water, baking soda in water, lukewarm water, or dish water.

2. Washout. Induce vomiting repeatedly.

3. Continue diluting and washing out until fluid is as clear as when it was swallowed.

4. Treat for shock.

**Burns

Shock and infection are chief dangers from burns. As a first aider, your duties are to relieve pain, prevent infection, and treat shock.

Burns of limited extent - apply sterile petroleum ointment or burn ointment, cover with sterile gauze.

Extensive burns are very serious - shock always present.

Remove loose clothing from burned area. If clothing sticks to burn, cut around it and leave for doctor to remove. Dip strips of clean cloth in solution of 3 tablespoons of baking soda or Epson Salts in one quart of warm water and apply cloth to burned area. Keep patient covered and warm.

**Broken Bones Or Dislocation

Remember: If in doubt, treat as a fracture. Proper handling of a fracture is essential.

1. Unless absolutely necessary, do not move the patient until the fracture has been immobilized by a splint.

2. Improvised splinting or immobilization material may be made from boards, wire, blankets, pillows, or folded coats. Pad the splint to make comfortable.

3. A general rule is to make splint long enough to immobilize both the break and the joints above and below the break.

Wounds, Bleeding Not Severe

1. Keep wound clean to prevent germs from entering wound.

2. If wound must be cleaned, use rubbing alcohol.

3. Apply antiseptic such as tincture of merthiolate or mild tincture of iodine.

4. Cover with sterile dressing and bandage snugly in place.

*Snake Bite

1. Keep patient quiet with bitten part elevated.

2. Tie a constricting band firmly around limb between bite and the heart. Should be tight enough to make veins stand out, but not tight enough to affect the deeper arteries and veins. If swelling causes too much constriction, the band must be loosened a little.

3. Make cross-cut incisions over each fang mark. Be careful to avoid large veins, arteries, and tendons.

4. Apply suction immediately and keep it up until a doctor can be reached.

Sprains

1. Elevate the part.
2. Apply cold.
3. If sprain is severe, have doctor examine it.

Insect Bites Or Sting

1. Remove the "stinger" if it is still present.

2. Apply paste made of baking soda or a compress moistened with ammonia water to relieve sting.

3. Cold applications will help relieve pain.

Only YOU can Do Your Job Safely!

APPENDIX

APPENDIX I

FIRE GLOSSARY

Anemometer. An instrument used to measure the velocity of wind.

Azimuth. A horizontal angle measured from north in a clockwise direction.

Azimuth Circle. A circle graduated in degrees in a clockwise direction.

Back Azimuth. Azimuth plus 180^{o} when Azimuth is 180^{o} or less. Azimuth minus 180^{o} when Azimuth is more than 180^{o}.

Backfire. In fire suppression, a fire set along the inner edge of a fire control line to reduce the fuel in advance of an actively spreading wildfire. The term applies best where skilled methods are required for successful execution. Where the strip of fuel is narrow or contains light fuels requiring no special skill to control the backfire, so that the backfire becomes a part of building the control line, the operation is usually called "burning out" or "clean burning".

Base Camp. A well located camp, when more than one camp is used, through which men, supplies, and equipment are assembled and distributed.

Berm. Outside or downhill shoulder of ditch or trench.

Blind Area. An area that cannot be seen directly by a lookout.

Board-of-Review. A group of fire control experts selected to: (1) define the problems and urgent needs on a recent fire; (2) evaluate the plans and action concerning these problems and needs; (3) prescribe ways to improve future fire control in similar situations.

Break-over. See Slop-over.

Bump-up Method. See Progressive Method.

Burning Out. Setting fire inside a control line to consume fuel between the edge of the fire and the control line. Also called Firing Out or Clean Burning. See Backfire.

Camp Boss. A person responsible for establishing and operating a fire camp.

Cat Boss. A person responsible for supervising usually 2 to 3 tractor-dozer operators and helpers to get efficient and productive use of the machines in constructing fire line.

Catface. A defection the surface of a tree or log, generally elliptical in shape, resulting from a wound in which healing was not re-established in the normal cross section.

Cat Line. Fire line constructed by a tractor with a bulldozer.

Checking Station. A contact point on main routes of travel, usually at or near the boundary of the forests, where traffic is checked and travelers contacted as a fire-prevention measure. Sometimes called "registration station."

Class A Fire. A fire of one-fourth acre or less.

Class B Fire. A fire of more than one-fourth acre, but less than 10 acres.

Class C Fire. A fire of 10 acres or more, but less than 100 acres.

Class D Fire. A fire of 100 acres or more, but less than 300 acres.

Class E Fire. A fire of 300 acres or more.

Clean Burning. See Burning Out.

Cold Trailing. A method of controlling a partly dead fire edge by carefully inspecting and feeling with the hand to detect any fire, digging out every live spot, and trenching any live fire edge.

Control a Fire. To complete control line around a fire, any spot fires therefrom, and any interior islands to be saved, burn out any unburned area adjacent to the fire side of the control lines, and mop-up until the lines can reasonably be expected to hold under foreseeable conditions.

Control Forces. Personnel and equipment used to control a fire.

Control Line. An inclusive term for all constructed or natural fire barriers and treated fire edge used to control a fire.

Control Time. Total time needed to control fire from the time of arrival of the first man until the fire is controlled.

Controlled Burning. See Prescribed Burning.

Coverage. The extent to which some standard, such as travel time or detection, has been met by an existing or a planned system.

Creeping. Behavior of a fire burning with a low flame and slow spread. See Smoldering, Running, Spotting.

Crew Boss. A person in charge of usually 5 to 30 firefighters and responsible for their performance, safety, and welfare for the duration of their assignment to him. (Sometimes called "foreman".) Supervised by a Sector Boss and usually supervises two or more Straw Bosses.

Cross-shot. Intersecting lines of sight from two points to the same object. Used to determine the location of a fire from lookouts.

Crown Fire. (1) When describing behavior - fire that advances from tree top to tree top or tops of shrubs more or less independent of the surface fire. Sometimes crown fires are classed as running or dependent, to distinguish the degree of independence from the surface fire. (2) When describing results - fire that consumes most of the upper foliage of trees or shrubs. See Crown Out.

Crown Out. Behavior of fire that intermittently develops sufficient heat near the ground to ignite the crowns of nearby trees or shrubs.

Crowning. Behavior of a fire advancing from crown to crown of trees or shrubs more less independent of fire on the ground.

Danger Class. A relative rating of the severity of forest fire danger as determined from burning conditions and other variable factors of fire danger.

Detection. The act or system of discovering and locating fires.

Direct Method. A method of suppression in which the burning edge is directly attacked in one or more of the following ways: digging or scraping a fireline at the burning edge, beating out the flames, extinguishing the fire with water or soil, or shoveling burning material inward.

Dispatcher. A person who receives reports of discovery and status of fires, determines their location, determines the quantity of men, equipment, and supplies needed to control fires, and sends them to the proper place.

Division. A unit of fire perimeter between designated relief, drainage, or cultural features. A division is usually organized into two to four sectors for control. Its size is such that the Division Boss can personally and completely inspect twice per shift.

Division Boss. A person responsible for all suppression work on a division under general instructions from the Fire Boss or a Line Boss acting for the Fire Boss. Usually supervises two or more Sector Bosses.

Drift Smoke. Smoke that has drifted from its point of origin.

Drop Spot. An area selected and marked as a target for supplies and equipment to be dropped usually by parachute.

Dry Storm. A lightning storm with very little rain.

Duff. The partly decomposed organic material of the forest floor beneath the litter or freshly fallen twigs, needles, and leaves.

Elapsed Time. Total time used to complete any given step or steps in fire suppression.

Elapsed Time Standards. Maximum amounts of time allowed for given steps of fire suppression.

Emergency Lookout. Station (or occupant) used only during periods of unusual danger or impaired visibility. Man often functions as a lookout-fireman.

Emergency Ration. Food assembled in advance ready for immediate transportation and use.

Equipment Officer. A person responsible for managing and servicing tools and mechanical equipment (except aerial) and pack stock needed when suppressing a fire.

Extra-Period Fire. A fire not controlled by 10 a.m. of the day following discovery.

Fag Station. A spot where smoking is permitted in an area that in general is closed to smoking.

False Alarm. A reported smoke or fire requiring no suppression, e.g., brush burning under control, mill smoke, false smoke. See False Smoke.

False Smoke. Anything likely to be mistaken for smoke, such as gray cliffs, sheep driveway or road dust, and fog.

Fingers of a Fire. Long, narrow tongues of burning area projecting out from main perimeter of fire.

Firebreak. A natural or constructed barrier, partly or completely clear of fuel, utilized to stop or check fires that may occur or to provide a control line from which to work. (Sometimes called a Firelane.)

Fire Boss. A person responsible for supervising all suppression and service activities on a fire. Primary responsibilities are to develop control plans and organize and direct the fire suppression organization in such manner that the fire is completely and efficiently controlled.

Fire Camp. A camp used to accommodate men and equipment while suppressing a fire. See Base Camp, Side Camp.

Fire Control. All activities to protect wild land from fire (includes prevention, presuppression, and suppression). See also Control a Fire.

Fire Control Equipment. All tools, machinery, special devices, and vehicles used in fire control, but excluding structures.

Fire Control Improvements. The structures primarily used for fire control, e.g., lookout towers, fire warden cabins, telephone lines, and roads to lookout station.

Fire Damage. The loss, expressed in money or other units, caused by fire. Includes all indirect losses, such as reduction in future values produced by the forest area, as well as direct losses of cover, improvements, and wildlife.

Fire Danger. The combination of all factors such as weather, fuels, and slopes affecting fire starts and fire spread.

Fire Danger Rating. An evaluation, usually by a numerical scale, of fire danger. See Fire Danger.

Fire Edge. The boundary of a fire at a given moment.

Fire Flank. The side of a fire between the point of greatest rate of spread and the rear.

Fireline. The part of a control line that is scraped or dug to mineral soil. Sometimes called Firetrail. See Control Line.

Fireman. A person whose principal function is fire suppression sometimes called Smokechaser.

Fireproof. To treat an area, hazard, or road so as to reduce the danger that fires will start or spread, e.g., to fireproof a roadside or campground.

Fire-Safety Officer. A person responsible for identifying the accident and health hazards to a fire suppression crew and for advising the Fire Boss and other supervisors concerning accident prevention measures.

Fire Season. The period or periods of the year during which fires are likely to occur, spread, and do sufficient damage to warrant organized fire control.

Fire-Tool Cache. A supply of fire tools and equipment assembled in planned quantities or standard units at a strategic point for exclusive use in fire suppression.

Firefinder. Instrument used at lookout points to determine location of fires.

Fire Weather Forecast. A weather prediction specially prepared for use in forest fire control.

Firing Out. See Burning Out.

First Attack. The first work done on a fire by the first person or persons arriving at the fire.

Flanking. Attacking a fire by working along the flanks either simultaneously or successively from an inactive or anchor point and endeavoring to connect the two lines at the head.

Flash Fuels. Fine fuels such as leaves, draped pine needles, fern, tree moss, and some kinds of slash or brush which ignite readily and are consumed rapidly.

Followup. The action of reinforcing the first man or men who go to a fire by sending additional men or equipment to facilitate suppression. Sometimes called Reinforcement.

Front of Fire. That part of the edge of the fire with greatest rate of spread. (Head of fire.)

Fuel Moisture Content. The quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried.

Fuel-Moisture Stick. A specially prepared stick or set ot sticks of known dry weight continuously exposed to the weather and periodically weighed to determine changes in moisture content as an indicator of moisture changes in similar sizes of forest fuels.

Fuel Type. An area having forest fuels, topography, and soil characteristics that will cause a given rate of fire spread during specified weather conditions and a given resistance to establishing and holding control line.

Getaway Time. Elapsed time beginning when the man being sent to a fire learns that there is a fire and ending when he starts to the fire.

GHQ. General headquarters on a large fire.

Ground Fire. Fire that consumes the organic material beneath the surface litter of the forest floor, e.g., a peat fire.

Hangover Fire. A fire that remains dormant for a considerable time.

Head of a Fire. See Front of Fire.

Heavy Fuels. Coarse fuels such as snags, logs and large limb-wood which ignite and are consumed more slowly than flash fuels, but produce more heat.

Heliport. A permanent or semi-permanent base for helicopters.

Helishot Crew. A suppression crew trained and equipped to make initial attack from a helicopter.

Helispot. A temporary landing spot for helicopters.

Helitanker. A tanker unit complete with tank, pump, and hose carried by a helicopter.

Hotshot Crew. An intensively trained forest firefighting crew, usually consisting of 20 or more men.

Hotspot. A particularly active part of a fire.

Hot-spotting. Checking the spread of fire either at points of more rapid spread or where it should be kept out of specific areas as a first step in control line construction.

Hour Control. A time standard in fire control which specifies the maximum allowable time (usually from origin of a fire to the first attack on it) that should ensure a burned acreage within the acceptable maximum for a given unit or cover type.

Incendiary Fire. A fire that is willfully set by anyone with the intention of burning over land or damaging property not owned or controlled by him.

Indirect Method. A method of suppression in which the control line is located along natural firebreaks, favorable breaks in topography, or at considerable distance from the fire and the intervening fuel is backfired or burned out. The strip to be backfired is wider than for the parallel method and usually allows a choice of the time at which the backfiring will be done.

Information Officer. A staff adviser to the Fire Boss on some fires, or to a Plans Chief if that position is filled, who is responsible for gathering and compiling all information needed to develop a suppression plan for the control of a fire.

Initial Attack. See First Attack.

Jump Spot. A selected landing area for smoke jumpers.

Legitimate Smoke. Smoke from any authorized use of fire as in locomotives, industrial operations, permitted debris burning, and similar operations.

Lightning Fires. A fire caused directly or indirectly by lightning.

Line Boss. A person responsible for executing the plans for fireline construction adopted by the Fire Boss in some stages of organization of large forces. May act as coordinator between two or more divisions.

Line Scout. A person responsible for obtaining accurate and timely information on the existing and prospective location and behavior of a fire and on the physical conditions that will affect plans for controlling it. Responsibility may be for the fire as a whole or for any designated portion of perimeter. May be assigned to assist any line officer.

Litter. The top layer of the forest floor which consists of loose debris of dead sticks, branches, twigs, and recently fallen leaves or needles, which have not started to decay.

Lookout. (1) A person designated to detect and report fires from a vantage point. (2) A lookout station.

Lookout Dispatcher. A person having the combined function of Lookout Man and Dispatcher.

Lookout-fireman. A person having the combined function of Lookout Man and Fireman.

Lookout House. A building containing living quarters with walls largely of glass, on a tower or natural elevation to permit an unobstructed view.

Lookout Man or Lookout Observer. A person at a lookout station employed to detect and report fires.

Lookout Station. A location and associated structures for detecting and reporting fires.

Lookout Tower. A structure to enable a person to be above nearby obstructions to sight. It is usually capped by either a lookout tower or observatory.

Man-caused Fires. Any fire not caused by lightning.

Maps and Records Officer. A person responsible for all current clerical duties of preparing administrative records of control of a fire such as tabulations of men and equipment, records of instructions, progress maps and organization charts.

Mop-up. All action such as extinguishing burning material and felling snags to prevent re-ignition or further spread after a fire is controlled.

Move-up Method. See Progressive Method.

One-Lick Method. See Progressive Method.

Parallel Method. A method of suppression in which the control line is constructed approximately parallel to, and just far enough from the fire edge to enable men and equipment to work effectively, though the line may be shortened by cutting across unburned fingers of fuel. The intervening strip of unburned fuel is normally burned out as the control line proceeds, but may be allowed to burn out unassisted where this occurs without undue delay.

Patrol. (1) To travel a given route to prevent, detect, and suppress fires. (2) To go back and forth watchfully over a length of control line, during or after its construction, to prevent breakovers, discover spot fires, or do mop-up.

Perimeter. The entire outer line or edge of the fire or the length of the outer line or edge of the fire.

Plans Chief. A staff adviser to the Fire Boss of large forces, who is responsible for the collection and analysis of all data needed by the Fire Boss when developing suppression plans.

Powersaw Boss. A person responsible for supervising usually 3 to 5 powersaw operators and helpers to get efficient and productive use of powersaws to cut snags or logs in constructing fireline.

Prescribed Burned. Skillful use of fire with natural fuels under the right conditions to allow holding the fire within the planned area. At times a part of the prescription determined to be necessary to improve an area for more desirable uses is to remove the cover by fire -- hence the term prescribed burning.

Preparedness. (1) Condition or degree of being completely ready to prevent or suppress fires. (2) Mental readiness to recognize increases in fire danger and act promptly when action is appropriate.

Presuppression. Activities in advance of fire occurrence to insure effective suppression action. Includes recruiting and training, planning the organization, maintaining fire equipment and fire control improvements, and procuring equipment and supplies. See Prevention. See Suppression.

Prevention. Acts designed to reduce the number of fires through law enforcement, education, control of risks, and abatement of hazards.

Prevention Fireman. A fireman who helps to prevent fires by contacting forest users and inspecting fire prevention measures and fire equipment of industrial operations on the forest. Assists with suppression work when fire occurs.

Prevention Patrolman. See Prevention Fireman.

Primary Lookout. An important lookout that must be manned throughout the fire season. The lookout man at a primary lookout is seldom sent to a fire.

Project Fire. A fire of such size and complexity that it requires a considerable staff organization.

Protection Boundary. An agreed upon boundary between areas of fire responsibility of protection agencies.

Progressive Method of Line Construction. A system of organizing men to build fireline in which they advance without changing relative positions in line. There are two principal methods of applying the system: (1) Work is begun with a suitable space, such as 15 feet, between men. Whenever one crewman overtakes another, all of those ahead move one space forward and resume work on the uncompleted part of the line. The last man does not move ahead until the work is complete in his space. Forward progress of the crew is coordinated by a crew leader. This method of organization is variously termed Move-up, Step-up, Bump-up, and Functional. (2) Each man does one lick or stroke of work and moves forward a specified distance. The distance is determined by the number of men equipped with a given tool. The distance is determined by the number of men equipped with a given tool and the number of licks needed per unit of line to complete the work for that tool. This method is rarely used and is termed One-lick.

Rear of a Fire. The portion of the edge of a fire opposite the head.

Reburn. Subsequent burning of an area in which fire has previously burned, but has left inflammable fuel, and has remained alive to spread again when burning conditions are more favorable.

Reinforcement. See Followup.

Relative Humidity. The amount of moisture in the air related to the total amount of moisture the air could hold at the current temperature.

Report Time. Elapsed time from the discovery of a fire until the first man who attacks the fire is notified of its existence and location. (Time of discovery to time of report.)

Resistance to Control. The relative difficulty of constructing and holding a control line as affected by resistance to line construction and fire behavior. See Resistance to Line Construction.

Resistance to Line Construction. The relative difficulty of constructing control line as determined by the fuel, topography, and soil. See Resistance to Control.

Risk. (1) The relative probability of fires starting, as determined by the presence or absence of causative agencies. (2) A causative agency.

Running. Behavior of a fire spreading rapidly with a well-defined head, but without spotting. See Smoldering, Creeping, Spotting.

Scratch Line. A narrow, shallow, preliminary fireline hastily constructed as an emergency measure to stop the spread of a fire.

Secondary Lookout. A lookout point used to supplement the visible area coverage of the primary lookouts when required by fire danger, poor visibility, or other factors.

Sector. A segment of fire perimeter or control line comprising the suppression unit for two or more crews under one Sector Boss and usually terminated by relief, drainage, or cultural features.

Seen Area. See Visible Area.

Service Chief. On fires with large forces, a person responsible for procuring, maintaining and distributing men, equipment, supplies, and facilities at the times and places specified by the suppression plans developed by the Fire Boss. Directly supervised by the Fire Boss and supervises work of the service unit.

Side Camp. A camp, usually small, to accommodate a crew working temporarily on an isolated sector. Also called Spike Camp.

Slash. Debris left after logging, pruning, thinning, or brush cutting. It includes cull logs, chunks, bark, branches, stumps, broken understory trees and brush.

Slash Disposal. Treatment of slash to reduce the fire hazard or for other purposes, but not necessarily to remove all of the slash. (Preferred to Brush Disposal.)

Slopover. Fire edge that crosses a control line or natural barrier intended to confine the fire. Also called Breakover.

Smokechaser. See Fireman.

Smokejumper. A firefighter who travels to fires by aircraft and parachute.

Smoldering. Behavior of a fire burning without flame and barely spreading. See Creeping, Running, Spotting.

Snag. A standing dead tree or part of a dead tree from which at least the leaves and smaller branches have fallen.

Speed of Attack. Elapsed time from origin of a fire to arrival of the first suppression force.

Sleeper Fire. See Hangover Fire.

Spike Camp. See Side Camp.

Spot Fires. Fires set in advance of or away from the main fire by flying sparks or embers.

Spotting. Behavior of a fire producing sparks or embers that are carried ahead by the wind and start new fires. See Smoldering, Creeping, Running.

Standby Crew. A group of men especially organized, trained, and placed for quick suppression work on fires.

Step-up Method. See Progressive Method.

Straw Boss. A working leader responsible for efficient and productive work of usually 3 to 6 firefighters. Supervised by a Crew Boss.

Supply Officer. A person responsible for supplying and distributing the supplies and equipment needed to suppress a fire and for servicing tools and simple equipment.

Suppression. All the work of extinguishing a fire beginning with its discovery. See Fire Control, Prevention. Presuppression.

Suppression Crew. Two or more men stationed at a strategic location, either regularly or in an emergency, for initial action on fires. Duties are essentially the same as those of individual firemen.

Surface Fire. Fire that burns surface litter, other loose debris of the forest floor, and small vegetation.

Tanker Boss. A person responsible for supervising usually 3 to 5 tanker operators and helpers to get efficient and productive use of the water in either direct attack or mop-up work on fires.

Travel Time. Elapsed time beginning when man starts to a fire and ending when he arrives at the fire and begins work.

Trench. A ditch dug or constructed along a slope below a fire, designed to catch rolling material.

Undercut Line. A fireline below a fire on a slope. Also called Underslung Line.

Visible Area. The ground or vegetation thereon that can normally be directly seen from a given lookout.

Water-Supply Map. A map showing location of supplies of water readily available for pumps, tanks, trucks, and camp use.

Wet Water. Water having increased spreading and penetrating properties due to added chemicals.

Wetting Agent. A chemical that reduces the surface tension of water and causes it to spread and penetrate more effectively.

APPENDIX II

24 HOUR CLOCK TIME

24 hour time is standard for use in preparation of fireman's diary, fire timeslips and all other fire control records.

Under this system the hours in the day are numbered in a single series of 24 hours. The numbering begins and ends at midnight.

Four digits are used to indicate the time. The first two indicate the hours past midnight. The last two indicate the minutes past the hour. Examples are as follows:

Conventional Time	24-Hour Time
Midnight	2400
12:01 A.M.	0001*
12:10 A.M.	0010
1:00 A.M.	0100
10:00 A.M.	1000
Noon	1200
1:00 P.M.	1300
6:00 P.M.	1800

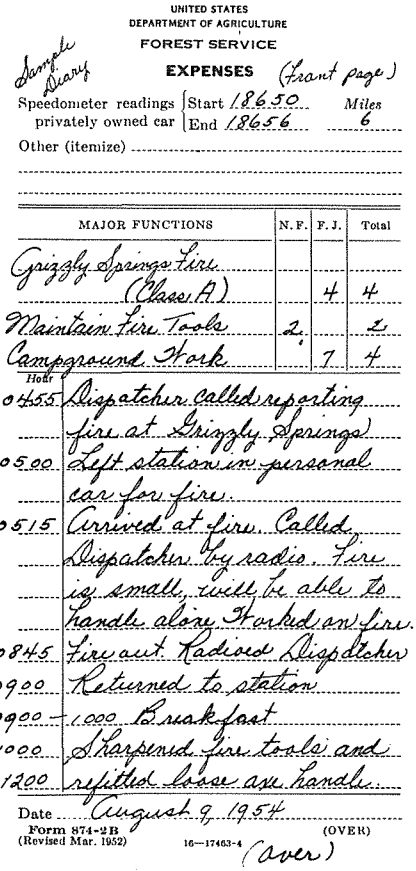
*The first two digits mean that the time is zero hours past midnight; the second two digits indicate that the time is one minute past the hour.

APPENDIX III

DIARY

Firemen are required to maintain official diaries in the standard form for all days on duty status. The kind of information recorded in the diary is as follows:

1. Major jobs done.
2. Time each job started and finished. (Record time in 24 hour clock time - see Appendix No. 2.)
3. Time of arrival and departure from official stations.
4. Route, mileage, mode of travel.
5. Names of forest officers, permittees, and other people contacted.
6. Duration and kind of leave taken.
7. Meals and lodging furnished by the government.



UNITED STATES
DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Sample Diary

EXPENSES (Front page)

Speedometer readings privately owned car: Start 18650, End 18656, Miles 6

Other (itemize)

MAJOR FUNCTIONS	N.F.	F.J.	Total
Grizzly Springs Fire (Class A)		4	4
Maintain Fire Tools	2		2
Campground Work		7	4

Hour	
0455	Dispatcher called reporting fire at Grizzly Springs
0500	Left station in personal car for fire.
0515	Arrived at fire. Called Dispatcher by radio. Fire is small, will be able to handle along Forked ax fire.
0845	Fire out. Radioed Dispatcher
0900	Returned to station
0900-1000	Breakfast
1000-1200	Sharpened fire tools and refitted loose ax handle.

Date August 9, 1954

Form 874-2B (Revised Mar. 1952) (OVER)

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(over)

(Back page)

Hour	
1200-1300	Lunch
1300	Started digging garbage pit in public camp back of station.
1700	Quit work for the day. Made check call to Dispatcher.

U. S. GOVERNMENT PRINTING OFFICE : 1954—O-327551

APPENDIX IV

AREA-PERIMETER TABLE

APPENDIX 17

Perimeter of fire corresponding with area enclosed by it.

Perimeter is shown in linear units of the same kind as the square units used for area.
If area is in square chains, perimeter is in chains.

Area	Minimum 1/ perimeter 1 C	Probable 2/ perimeter 1.5 C	Maximum 3/ perimeter 2 C	Area	Minimum perimeter 1 C	Probable perimeter 1.5 C	Maximum perimeter 2 C
1	3.5	5.25	7.00	210	51.4	77.10	102.80
2	5.0	7.50	10.00	220	52.5	78.75	105.00
3	6.1	9.15	12.20	230	53.7	80.55	107.40
4	7.1	10.65	14.20	240	54.8	82.20	109.60
5	8.0	12.00	16.00	250	56.0	84.00	112.00
6	8.7	13.05	17.40	260	57.1	85.65	114.20
7	9.4	14.10	18.80	270	58.3	87.45	116.60
8	10.0	15.00	20.00	280	59.4	89.10	118.80
9	10.6	15.90	21.20	290	60.4	90.60	120.80
10	11.2	16.80	22.40	300	61.5	92.25	123.00
11	11.7	17.55	23.40	320	63.4	95.10	126.80
12	12.3	18.45	24.60	340	65.4	98.10	130.80
13	12.8	19.20	25.60	360	67.2	100.80	134.40
14	13.2	19.80	26.40	380	69.1	103.65	138.20
15	13.7	20.55	27.40	400	70.9	106.35	141.80
16	14.2	21.30	28.40	425	73.1	109.65	146.20
17	14.6	21.90	29.20	450	75.2	112.80	150.40
18	15.1	22.65	30.20	475	77.2	115.80	154.40
19	15.5	23.25	31.00	500	79.3	118.95	158.60
20.0	15.9	23.85	31.80	550	83.2	124.80	166.40
22.5	16.8	25.20	33.60	600	86.8	130.20	173.60
25.0	17.7	26.55	35.40	650	90.4	135.60	180.80
27.5	18.6	27.90	37.20	700	93.7	140.55	187.40
30.0	19.4	29.10	38.80	750	97.0	145.50	194.00
32.5	20.3	30.45	40.60	800	100.2	150.30	200.40
35.0	21.0	31.50	42.00	850	103.4	155.10	206.80
37.5	21.7	32.55	43.40	900	106.3	159.45	212.60
40.0	22.4	33.60	44.80	950	109.3	163.95	218.60
42.5	23.2	34.80	46.40	1000	112.1	168.15	224.20
45.0	23.7	35.55	47.40	1050	114.8	172.20	229.60
47.5	24.5	36.75	49.00	1100	117.5	176.25	235.00
50.0	25.0	37.50	50.00	1150	120.2	180.30	240.40
52.5	25.8	38.70	51.60	1200	122.8	184.20	245.60
55.0	26.3	39.45	52.60	1250	125.4	188.10	250.80
57.5	26.8	40.20	53.60	1300	127.8	191.70	255.60
60.0	27.5	41.25	55.00	1350	130.3	195.45	260.60
65.0	28.6	42.90	57.20	1400	132.6	198.90	265.20
70.0	29.7	44.55	59.40	1450	134.9	202.35	269.80
75.0	30.7	46.05	61.40	1500	137.3	205.95	274.60
80.0	31.7	47.55	63.40	1550	139.6	209.40	279.20
85.0	32.6	48.90	65.20	1600	141.8	212.70	283.60
90.0	33.6	50.40	67.20	1650	144.0	216.00	288.00
95.0	34.6	51.90	69.20	1700	146.1	219.15	292.20
100.0	35.5	53.25	71.00	1750	148.3	222.45	296.60
110.0	37.2	55.80	74.40	1800	150.4	225.60	300.80
120.0	38.7	58.05	77.40	1850	152.5	228.75	305.00
130.0	40.4	60.60	80.80	1900	154.6	231.90	309.20
140.0	41.9	62.85	83.80	1950	156.5	234.75	313.00
150.0	43.3	64.95	86.60	2000	158.6	237.90	317.20
160.0	44.8	67.20	89.60	2050	160.5	240.75	321.00
170.0	46.2	69.30	92.40	2100	162.5	243.75	325.00
180.0	47.5	71.25	95.00	2150	164.4	246.60	328.80
190.0	48.8	73.20	97.60	2200	166.3	249.45	332.60
200.0	50.2	75.30	100.40				

1/ Perimeter is that of a circle corresponding with the area.
2/ Perimeter is 1.5 times that of a circle corresponding with the area.
3/ Perimeter is 2.0 times that of a circle corresponding with the area.

Perimeter of fire corresponding with area enclosed by it.

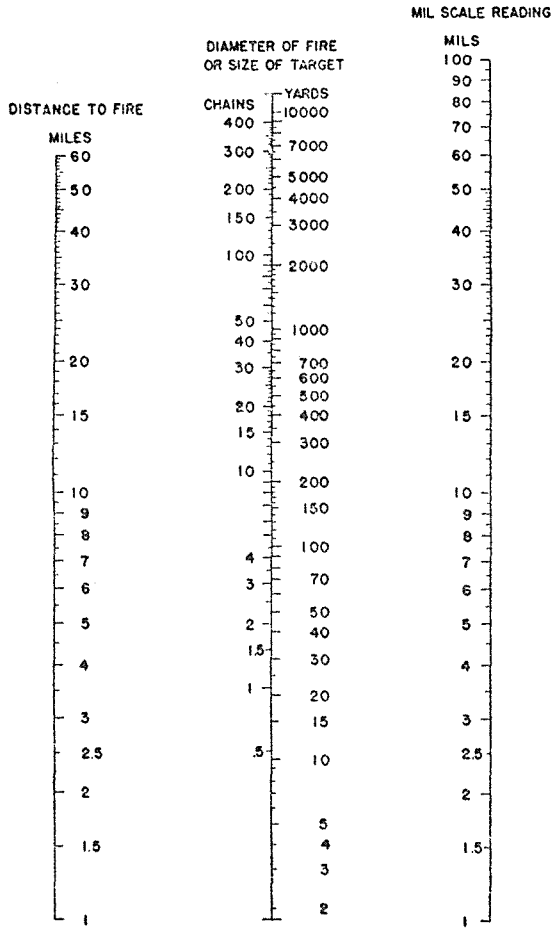
Perimeter is shown in linear units of the same kind as the square units used for area.
If area is in square feet, perimeter is in feet.

Area	Minimum 1/ perimeter 1 C	Probable 2/ perimeter 1.5 C	Maximum 3/ perimeter 2 C	Area	Minimum perimeter 1 C	Probable perimeter 1.5 C	Maximum perimeter 2 C
2,000	159	238	318	102,000	1132	1696	2264
4,000	222	334	445	104,000	1144	1716	2288
6,000	270	405	540	106,000	1154	1731	2308
8,000	317	476	635	108,000	1165	1747	2330
10,000	355	532	710	110,000	1175	1762	2350
12,000	388	581	775	112,000	1185	1777	2370
14,000	417	626	835	114,000	1196	1794	2392
16,000	447	670	893	116,000	1206	1810	2413
18,000	475	712	950	118,000	1216	1824	2432
20,000	500	750	1000	120,000	1226	1839	2452
22,000	525	787	1050	122,000	1236	1854	2472
24,000	550	825	1100	124,000	1246	1869	2492
26,000	574	861	1148	126,000	1257	1885	2514
28,000	595	892	1190	128,000	1266	1899	2532
30,000	615	922	1230	130,000	1275	1912	2550
32,000	635	952	1270	132,000	1286	1929	2572
34,000	655	982	1310	134,000	1295	1942	2590
36,000	675	1012	1350	136,000	1305	1957	2610
38,000	692	1039	1385	138,000	1315	1972	2630
40,000	710	1065	1420	140,000	1324	1986	2648
42,000	727	1091	1455	142,000	1334	2001	2668
44,000	745	1117	1490	144,000	1343	2014	2686
46,000	762	1144	1525	146,000	1351	2026	2702
48,000	778	1168	1557	148,000	1360	2040	2720
50,000	794	1191	1588	150,000	1370	2055	2740
52,000	810	1215	1620	152,000	1379	2068	2758
54,000	825	1237	1650	154,000	1387	2081	2775
56,000	840	1260	1680	156,000	1396	2094	2792
58,000	855	1282	1710	158,000	1405	2107	2810
60,000	870	1305	1740	160,000	1413	2119	2826
62,000	885	1327	1770	162,000	1422	2134	2845
64,000	899	1348	1798	164,000	1431	2146	2862
66,000	912	1369	1825	166,000	1440	2160	2880
68,000	926	1390	1853	168,000	1449	2173	2898
70,000	940	1410	1880	170,000	1456	2184	2912
72,000	953	1429	1905	172,000	1465	2197	2930
74,000	966	1450	1933	174,000	1474	2211	2948
76,000	979	1468	1958	176,000	1481	2221	2962
78,000	992	1488	1984	178,000	1490	2235	2980
80,000	1004	1506	2008	180,000	1499	2248	2998
82,000	1016	1524	2032	182,000	1508	2262	3016
84,000	1028	1543	2057	184,000	1516	2274	3032
86,000	1040	1560	2080	186,000	1525	2287	3050
88,000	1052	1579	2105	188,000	1537	2306	3075
90,000	1064	1596	2128	190,000	1541	2311	3082
92,000	1075	1612	2150	192,000	1550	2325	3100
94,000	1087	1631	2175	194,000	1559	2338	3118
96,000	1099	1648	2198	196,000	1566	2349	3132
98,000	1110	1665	2220	198,000	1575	2362	3150
100,000	1121	1681	2242	200,000	1581	2371	3162

1/ Perimeter is that of a circle corresponding with the area.
2/ Perimeter is 1.5 times that of a circle corresponding with the area.
3/ Perimeter is 2.0 times that of a circle corresponding with the area.

APPENDIX V

CHART FOR USE WITH MIL-SCALE TO OBTAIN DIAMETERS OF FIRES



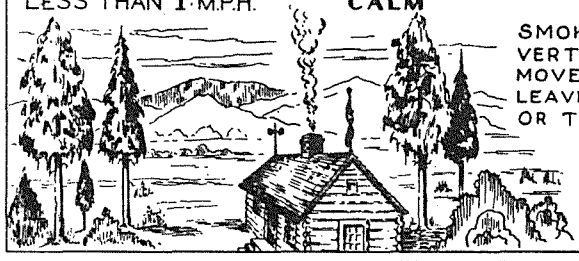
Mil-scale is found in some of the lookout's binoculars.

CALIFORNIA
SCALE OF WIND VELOCITY

FOR USE IN ESTIMATING WIND VELOCITIES IN REGION 5

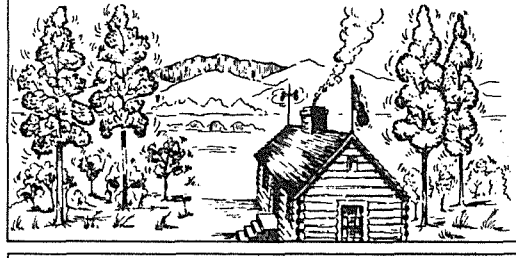
WIND CLASS	TERMS USED IN U.S.W.B. FORECASTS	EFFECTS OF WIND

LESS THAN 1 M.P.H. — **CALM**



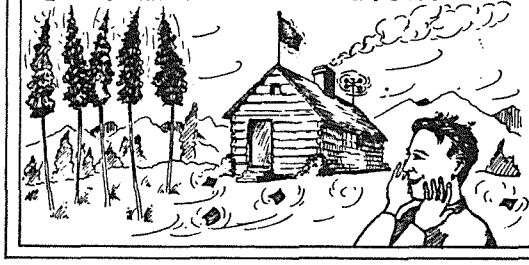
SMOKE RISES VERTICALLY; NO MOVEMENT OF LEAVES OF BUSHES OR TREES.

1 TO 3 M.P.H. — **VERY LIGHT**



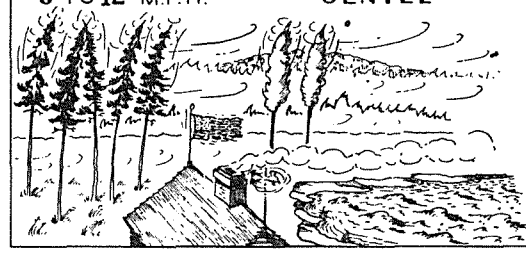
LEAVES OF QUAKING ASPEN IN CONSTANT MOTION; SMALL BRANCHES OF BUSHES SWAY; SLENDER BRANCHLETS AND TWIGS OF TREES MOVE GENTLY; TALL GRASSES AND WEEDS SWAY AND BEND WITH WIND; WIND VANE BARELY MOVES.

4 TO 7 M.P.H. — **LIGHT**



TREES OF POLE SIZE IN THE OPEN SWAY GENTLY; WIND FELT DISTINCTLY ON FACE; LOOSE SCRAPS OF PAPER MOVE; WIND FLUTTERS SMALL FLAG.

8 TO 12 M.P.H. — **GENTLE**



TREES OF POLE SIZE IN THE OPEN SWAY VERY NOTICEABLY; LARGE BRANCHES OF POLE-SIZE TREES IN THE OPEN TOSS; TOPS OF TREES IN DENSE STANDS SWAY; WIND EXTENDS SMALL FLAG; A FEW CRESTED WAVES FORM ON LAKES.

13 TO 18 M.P.H. — **MODERATE**

TREES OF POLE SIZE IN THE OPEN SWAY VIOLENTLY; WHOLE TREES IN DENSE STANDS SWAY NOTICEABLY; DUST IS RAISED IN ROAD.

19 TO 24 M.P.H. — **FRESH**

BRANCHLETS ARE BROKEN FROM TREES; INCONVENIENCE IS FELT IN WALKING AGAINST WIND.

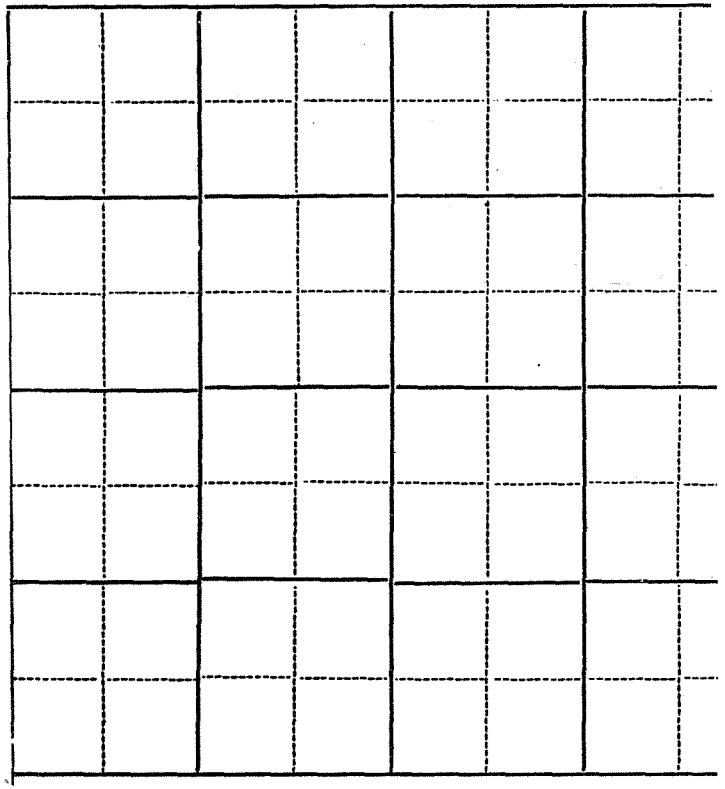
25 TO 38 M.P.H. — **STRONG**

TREES ARE SEVERELY DAMAGED BY BREAKING OF TOPS AND BRANCHES; PROGRESS IS IMPEDED WHEN WALKING AGAINST WIND; STRUCTURAL DAMAGE. SHINGLES ARE BLOWN OFF.

APPENDIX VII

FIREMAN'S REPORT

FIRE MAP RECORD



Scale—....." = 1 Mile

Section.....Twp.....Rge.....Mer.....

Fireman.....

Form 144-R-5
(Revised April, 1954)

FIREMAN'S REPORT

		DATE	HOUR
1.	Name of Fire _____ 2. Date _____		
3.	Cause _____ 4. Class of People _____		
5.	Time Fire Started (Guess__ Known__)		
6.	Discovered by _____		
7.	Location of Discoverer _____		
8.	Time Reported to You _____ (Location)		
9.	Time of First Attack _____ (No.Men) (Boss)		
10.	Type of First Attack _____		
11.	Time of First Reenforcements _____ (No. Men)		
12.	Time Fire Controlled _____		
13.	Time Fire Mopped Up _____		
14.	Time Fire Out _____		
15.	Timber Type--Vicinity of Point of Origin _____		
16.	Specific Fuels in Which Fire Spread _____		
17.	Fuel Type Prevailing on Burned Area _____		
18.	Man Hours to Control _____		
19.	Man Hours to Mop Up _____		
20.	Point of Origin in Ft. from Outer Track--Road or RR _____		
21.	Slope Faces _____		
22.	Method of Travel _____		
23.	Distance Traveled--Miles _____		
24.	Line Held by Tankers (Chains) _____		
25.	Line Built by Dozers (Chains) _____		
26.	Line Built by Hand Tools (Chains) _____		
27.	Area When Attacked _____		
28.	Area When Controlled _____		
29.	Perimeter When Controlled (Chains) _____		
30.	Maximum Number of Line Workers _____		

(Map on back of this form)

73a

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